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House buyer perceptions on the value of water and
grey water recycling systems

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grey water recycling systems

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ABSTRACT

The population of the East of England is set to increase and climate change predictions suggest that the region will become drier; water resources will therefore come under increasing pressure. In order to meet future water demand and deliver a reliable supply in the years to come, Cambridge Water is assessing the feasibility of installing grey water recycling systems in future housing developments. Grey water is wastewater from showers, baths, and wash basins. Recycling this water is an innovative way to conserve water. Treated grey water is used principally for toilet flushing - which represents about a third of water use in a typical UK household - but also for watering gardens and washing cars.

This study investigated house buyer perceptions on the value of water and grey water recycling systems. For this purpose 2000 customers were surveyed using a questionnaire. The aim was to inform Cambridge Water as a water supplier of how receptive their customers would be to receiving a secondary supply of treated grey water for non-potable use. All those sampled had moved into a newly built home in the past two years. Since investing in grey water recycling systems would have little or no financial benefit for the homeowner, the study focused on other potential benefits.

The response rate for the survey was 22 per cent and the quantitative data was analysed using descriptive statistics. The results show that there was widespread support for the domestic use of grey water. The overwhelming majority of respondents would be willing to invest in grey water recycling systems because they are concerned about the environment, and to ensure a reliable supply at times of water scarcity. Many of those that objected stated that they would need further information before giving their consent.

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1 BACKGROUND TO PROJECT

1.1 Introduction

The average person uses 130 litres of water every day. This is the same as one full bath and five flushes of the toilet each day. In the future, water supplies in the East of England will come under increasing pressure as the region is expected to become drier due to climate change. At the same time, the population is set to grow. In order to meet future water demand and deliver a reliable supply in the years to come, Cambridge Water is assessing the feasibility of installing grey water recycling systems in future housing developments. Grey water recycling is an innovative water conservation technology whereby treated grey water is used principally for toilet flushing - which represents about a third of water use in a typical UK household - but also for watering gardens and washing cars.

Grey water is wastewater from showers, baths, and wash basins. Grey water can be reused after it has been filtered to remove hair, skin and soap products from the water and chemically or biologically treated. The potential level of human contact with the water in its end use will determine what level of treatment is required. After treatment it can be used in the place of drinking water for many household non-potable functions to significantly reduce water consumption. The widespread implementation of grey water recycling systems could help to take pressure off water resources.

The real cost of a grey water recycling system to a homebuyer would be between £5000 - £6000, but Cambridge Water is prepared to contribute £1000 per system. Making the real additional cost to a home £4000 - £5000, this would add 2.5 – 4% onto the cost of the average home. The cost to someone buying a flat would be less because of reduced infrastructure, adding 1% onto the cost of the flat. It is thought that if developers could be convinced of the public willingness to have grey water systems, the extra cost of the infrastructure could be added to the final asking price without detriment to the saleability.

New towns have been built cheaply in the past; many interested parties are keen to see the new towns of 21st Century built with the future in mind. The Homes and Communities Agency is pressing developers to do so but they argue customers won't pay. However with evidence of public interest, grey water recycling systems would ideally become part of the building codes with planners enforcing their inclusion in new builds.

1.2 Focus of the research

Some customers adopting the use of grey water early could see a drop in their water bills. However this is not really the issue because the extra plumbing and grey water treatment facilities are expensive. Customers would not really be investing to save money as pay back periods will be long, if it does eventually pay for itself. In essence customers will be investing in this technology to ensure a reliable water supply for themselves in the future and to contribute to environmental sustainability. It is a way of adapting to climate change and population growth within the region.

The most viable way to introduce grey water recycling systems is to install them during the construction of new builds. Therefore this research focuses on Cambridge Water customers who have moved into a newly built home in the past two years. This is because they made the decision to purchase a newly built home. By gauging their opinion, one can understand how strongly water issues feature in the minds of house buyers. This work is sponsored by Cambridge Water who will use the findings to inform the way they meet future water demand. The core aim of the project is:

To inform Cambridge Water as a water supplier of how receptive their customers would be to receiving a secondary supply of treated grey water for non-potable use.

Using a survey based approach; the research will generate information on house buyer attitudes towards the value of water and the value of domestic water recycling systems. The work will inform both Cambridge Water and housing developers about the feasibility of selling houses which possess a secondary non-potable supply derived from treated grey water. Specific questions to be addressed are:

- Do homeowners believe it is their responsibility to act on their environmental concerns?
- Would the desire to ensure outdoor water use persuade people to invest in grey water technology?
- Are the concept and practicalities of using recycled water acceptable for homeowners?

1.3 Outline of the thesis

The study will firstly review the literature to establish what it already known about public acceptance of grey water recycling systems. Then the methodology used to collect the data is explained, i.e. the self-complete questionnaire sent to 2000 Cambridge Water customers. The quantitative data is then presented and analysed

using descriptive statistics. Finally the study concludes with the conclusions and recommendations.

2 LITERATURE REVIEW

2.1 Introduction

2.1.1 Water scarcity

Water stress occurs “when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use” (United Nations Environment Programme, 2005). Globally the number of people living under water stress conditions is rising (BBC, 2009), and it is predicted this trend will continue. The FAO has stated that “by 2025, 1 800 million people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions” (Food and Agriculture Organization, 2009).

Climate change is the cause of water scarcity; many regions of the world are experiencing reduced rainfall resulting in a decreased amount of freshwater being available. Compounding this situation is population growth and urbanisation, the water supply available to each person is reduced and the water quality is compromised. Urban areas generate a lot of pollution that can lead to the degradation of water resources, for example eutrophication and organic matter pollution. This results in a reduction of the potable water available, saline intrusion also has this effect and often occurs if a coastal aquifer is over exploited.

2.1.2 Water recycling

In the driest regions of the world the concept of reusing wastewater is being considered in those countries anticipating a water shortage. Australia has been experiencing drought conditions for the past several years. In reaction to the obvious water shortages the water agencies have pushed forward with water recycling systems. The largest water recycling scheme in Australia is to be found at Rouse Hill, where it provides up to 1.4 billion litres of recycled water each year (Sydney Water, 2009).

In a typical UK home using a nine litre toilet, 30 per cent of the water consumed is used to flush the toilet (Environment Agency, 2009). Toilet flushing is one area where recycled water can easily be used to substitute potable water. In new houses 45 per cent of the total water used is accounted for by showers and baths (Environment Agency, 2009). Reusing this water for just toilet flushing would dramatically reduce

households consumption of potable mains water, even greater if the recycled water was used further, for garden irrigation and car washing for example. Reducing overall household water consumption means less water has to be abstracted, resulting in a positive impact on the environment. It will mitigate the effects of a drier climate in addition to helping meet the greater demand due to population growth.

2.1.3 Implementation challenges

The Singapore government started in 1998 what was to become an indirect potable reuse project (Public Utilities Board, 2008). What was branded as NEWater is an attempt to reduce the dependency Singapore has on Malaysia for its water resources. NEWater is wastewater treated to a very high standard and then returned to reservoirs to be mixed with raw water. This is not because the NEWater has to be diluted in order to make it safe to drink, but rather to overcome people's physiological barriers to drinking recycled water. It is not a new practice as it has been used in the USA for more than 20 years (Public Utilities Board, 2008). Initially there was hesitation about using the blended NEWater, evidence for which could be attributed to an increase in sales of bottled water (Po et al, 2003, p. 9). However a large education campaign assuring the population of the safety of NEWater, as well as personal experience of not becoming unwell as a result of drinking it can be credited with its acceptance by most Singaporeans. (Public Utilities Board, 2008).

The San Diego water repurification project was similar to that of the NEWater in Singapore. Untreated recycled water would be added to the freshwater in reservoirs, then after being held back for a year would be treated conventionally and piped to homes. The idea first came about during the 1991-92 droughts and from 1997 onwards public information and outreach campaigns were carried out (Po et al, 2003, p. 10). The consultations with focus groups and community leaders showed that after reassurance there was strong support for the project. However the project was caught up in political campaigns, with opponents widely exaggerating the health risks. It was claimed the wastewater of the affluent areas would become the drinking water of the poorer districts. The project is currently on hold (Po et al, 2003, p. 11).

The San Gabriel Valley groundwater recharge project was similar to the San Diego repurification project in that it has faced set-backs at the consultation stage due to effective counter campaigns. A citizens group placed several advertisements in local newspapers with the headline of "Toilet to Tap"; telling readers that the health risk although small was intolerable, as was the environmental impact. A local brewery, the Miller Brewing Company also lodged a lawsuit against the projects, fearing that their water source would be polluted. Currently the project is still ongoing. (Po et al, 2003, p. 11).

The country that really pioneered water recycling was the USA; California in particular has over 230 water reuse projects in operation. Most of the projects recycle water for non-potable uses; however four do provide recycled water for indirect potable uses (Po et al, 2003, p. 6). The Irvine Ranch Water Recycling Program started using recycled water for the agricultural sector in 1967 and since then has extended its use to golf courses, public landscaped areas and industrial uses. The project also supplies recycled water to commercial building for toilet flushing (Irvine Ranch Water District, 2009). The Irvine Ranch Water Recycling Program successfully managed to gain acceptance by educating the community about water conservation and reuse. One of the activities the water supplier does is to host regular water awareness tours for the residents of the district (Irvine Ranch Water District, 2009). These types of activities remind the community about the shortage of water in their district.

There are common factors across the examples of acceptance and rejection of water recycling around the world. The main reason for rejection being people not wanting to use recycled water because of their perception of it as dirty. The main reason for its acceptance is that the public realise it will help to alleviate drought conditions, providing them with more reliable and plentiful water supplies. It seems that in many cases it is local authority or action group with the most effective publicity campaign that determines the fate of a water recycling project; the ability to get the local press onside being crucial. It is important of course to achieve a high level of acceptance if the intention is to get people to invest in these systems. People will have to see a definite value to using recycled water if they are to invest their own money in a system.

2.2 Grey water recycling

2.2.1 General characteristics

Grey water is wastewater from showers, baths, and wash basins. Water can also be collected from kitchen sinks and dishwashers but this is not usually used as it is more heavily contaminated. Reusing grey water can be a low tech or high tech activity. In its simplest form it can be a private individual saving their bath water to use for watering the garden for example. At the other end of the scale houses are now being built with dual plumbing to supply homes with both potable and treated grey water. The grey water is collected and treated locally at a small plant, then can be reused after it has been filtered to remove hair, skin and soap products from the water and chemically or biologically treated.

The potential level of human contact with the water in its end use will determine what level of treatment is required (CIWEM, 2006). It is typically used to wash cars, water

gardens and flush toilets. The high tech solutions are commonly found in the higher income countries; this level of grey water recycling is what is proposed for the new builds in the East of England. The water suppliers would like housing developers to start installing grey water recycling systems into new housing developments. House buyers would be asked to pay more for a grey water equipped house, but it is hoped they would see advantages in owning a home with a water recycling system. The water supplier would then operate the treatment facility and customers would pay a lower rate for the recycled water.

2.2.2 An example of an existing grey water scheme

In Australia local governments and private individuals have been experimenting with water recycling since the early 1990s (Po et al, 2003, p. 4). Initially starting out as small scale ventures they are now being widely adopted and scaled up. Reuse projects can now be found across Australia in every state. Australia is the driest inhabited continent in the world (Australian Government, 2006). Its people have always had to make do with limited scarce water resources and in the past very low population densities have made this possible. In recent years (2003 to the present day) droughts have plagued many areas of Australia and water reuse systems have been implemented to ensure water supply is maintained.

The Rouse Hill development is home to Australia's biggest residential wastewater recycling scheme (Sydney Water, 2009). The residents have now been supplied with recycled water for eight years, which is for use in the garden, fighting fires and toilet flushing. A survey of the residents revealed that some people were unfamiliar with the treatment processes that the recycled water goes through, and whether or not human waste was being recycled. However generally there was a sense of pride in the community about their water recycling systems (Po et al, 2003, p. 4). The scheme will eventually serve 36,000 homes and treat up to 4.7 billion litres of water every year for non-potable use (Sydney Water, 2009).

At the start of the scheme the customers were charged a very low rate for the recycled water to encourage use. As a result the demand for the grey water was initially greater than the supply and potable water had to be used instead (Po et al, 2003). Partly this was because of failures with the treatment plant but also because the customers accepted and gladly used the lower rate water. Ongoing efforts have been made to educate the customers about the 'conditions of use' of the recycled water. This is primarily to reduce the health risk posed by the grey water, the greatest concern being cross-connections. Local plumbers and customers are informed of the importance of keeping the pipes carrying the recycled water away from those carrying potable water. The price of the grey water has now been increased to reflect the need

to also conserve the recycled water, as Australia continues to suffer from drought conditions (*ibid*).

2.2.3 Challenges

HEALTH CONCERNS

A major concern for people when contemplating grey water recycling is health impacts. People understandably do not want to adopt something that is going to be damaging to their wellbeing. The terms 'reuse', 'recycled' and 'grey water' conjure up in the minds of customers something that has been dirtied and to some people is something to be avoided. The 'law of contagion' applies, the law suggests "that a neutral object may acquire disgusting properties from another object through brief contact (e.g. hair in the soup)" (Po et al, 2003, p. 16). So even if the grey water has been treated in line with all the standards, people may still regard it as contaminated.

To achieve public approval for grey water recycling systems the public must be reassured that recycled water is safe. A 2003 survey of the UK public asked people if they were in theory supportive of water recycling, 89% of respondents said they would have no objection to the concept as long as it was safe. A similar number, 88% said they were happy to flush the toilet using water from their own bath and shower (Jeffrey, 2003, p. 111). This helped to confirmed an understanding that is well established in the literature, that "using personal sources of water for recycling will be preferred to public sources, which in turn, will be preferred to identifiable second party sources" (Jeffrey, 2003, p. 114}). Scaling up the grey water recycling system makes it most cost effective, a potential challenge to grey water recycling would come if people refuse to use only their own water recycled from their own home.

PUBLIC BELIEF

For a grey water recycling schemes to be implemented in the UK, sectors of the British public would have to be convinced of its necessity and worth. A recent survey commissioned by the European Commission found that the northern Members States of the EU showed little to no concern about water quantity, be it shortage or excess. The southern Member States on the other hand were concerned, which is understandable given the problems they are confronted with. The 15-24 years olds were the least concerned group about quality and quantity across the EU. EU citizens in general thought industry and agriculture had the largest impact on water. However they did recognise individual households' impact (45% thought they had a "large impact") (The Gallup Organisation, 2009, p. 20). As a possible result of this attitude a large majority of Europeans indicated that they have been trying to use less water and

using eco-friendly household chemicals as well as avoiding using chemicals in the garden.

EU citizens' views on climate change was mixed, changed ecosystems, rising sea levels, more floods and increasing water scarcity, were all chosen by one-fifth of the respondents (The Gallup Organisation, 2009, p. 42). Of the EU citizens sampled just 7% thought that climate change would not significantly impact their country's water ecosystem (*ibid*). Of particular interest to this study is that citizens from three North-western Member States, Britain, Ireland and the Netherlands think that climate change will most likely bring an excess of water. Rising sea levels and flooding is a greater concern than a scarcity of water.

Another study corroborated the European study in also finding the UK public was sceptical about the likelihood of climate change causing a shortage of water. Of the respondents, 56% thought that in some parts of the UK rainfall was actually decreasing; however 84% agreed that it still rains enough in the UK too not have any water supply problems (Jeffrey, 2003, p. 112). If UK citizens believe that water is likely to be more abundant in the future, it could mean people would be less willing to accept the need to value it more highly. This would be a barrier to the introduction of grey water recycling systems.

COST

The price of grey water recycling systems has been a major barrier to their introduction; the cost of equipment is coming down but is still currently substantial (Mercoriet, L. 2008). In the East of England it has been estimated that the amount added to a new home would be in the order of £5000-£6000 for it to be grey water ready (Cambridge Water, 2009). The breakdown of that cost is the household's share of the treatment plant cost, and the extra plumbing that would be needed in the house to supply the recycled water. By using cheaper rate recycled water, customers would reduce their annual water bill. However the magnitude of the yearly savings is unlikely to be large enough to make financial sense in terms of payback periods. It is thought the current pay back period for a grey water recycling system would be in the tens of years if it did indeed ever pay for itself (Cambridge Water, 2009).

It is hoped home buyers will invest in these systems because they see their wider and utility value. For example helping to look after the environment and avoiding water restrictions. There would be financial gain if lots of people begin to see value in having a grey water supply. Grey water equipped homes could start to fetch a premium and the original owners would then see a direct return on their investment when they came to sell. This interest in grey water equipped homes could theoretically come quickly. If there were to be a few consecutive years of low rainfall there might be

temporary interest. In the long term the interest could be permanent if climate change makes parts of the UK considerably drier. It is possible those investing in grey water early would benefit from government and water supplier subsidies and therefore would gain most at the point of resale.

2.3 Public attitudes towards grey water recycling

2.3.1 Conditions for the acceptance of grey water recycling

CONCERN FOR THE ENVIRONMENT

The level of consciousness the public has for the environment plays a large part in the way they consider, consume and are concerned about water. Generally those people who are aware of the problems threatening the environment will see water resources as something at risk, which need to be carefully managed to ensure supply and not degradation of the environment. On the flip side people who view water as a low concern probably do not worry about environmental problems unless they are directly affected. If the river running next to someone's home appears to be polluted then they will be immediately concerned, but maybe only on that particular issue and not the environment as a whole.

On the much larger issue of climate change, one UK study found that the public were not convinced it was a problem yet. Just half of the people surveyed thought rainfall levels were decreasing and most thought it rained enough to prevent any problems with water supply (Jeffrey, 2003, p. 112). It would seem that saving water to save money is more important to people than saving water to help the environment. In a recent survey answered by 2195 people, 92% of respondents agreed water saving was important to save money, compared to only 48% who thought saving water helps the environment. In fact 16% of respondents actually disagreed with the statement saying that saving water is beneficial to the environment (Savills Research, 2009, p. 2).

WILLINGNESS TO VALUE WATER MORE HIGHLY

Socio-demographic factors also play a role in the acceptance of grey water. Within a region different household may have vastly varying levels of water consumption. It is obvious that the more people a household is home to, the greater the amount of water it will use. Other traditionally big users of water are wealthier households and those not on a meter. Households with a high income tend to have large gardens, swimming pools and lots of cars to clean for example. They can afford to pay for more water, which is currently a relatively cheap resource; they have no incentive to save water because the cost of using more is not substantial. Homes not on a meter likewise reap no personal benefit from saving water.

“The value of water is not static” (Medd, 2005, p. 5). Its value varies according to the person using it, the purpose and the environment in which it is used. We can refer to the “utility value” or “exchange value” of water, in order to achieve “positional goods” that hold a symbolic value (*ibid*). Swimming pools for example would be useless without water, but once filled they are a desirable commodity. Power showers are another example of a positional good, where water consumption is a necessary element. People value having a power shower for the additional feeling of cleanliness it gives, and whereas they might be aware of the extra electricity they are using, the extra water used could be overlooked. Power showers use between 20 and 50 litres a minute (Southerton, 2004, p. 42). It is the common belief that showers consume less water than a bath, however with a bath consuming an average 80 litres and the average shower taking seven to eight minutes, it is clear power showers in fact use a great deal of water. So it could be argued that people are undervaluing water because they cannot see the full extent of their consumption.

VALUE OF WATER FOR DIFFERENT FUNCTIONS

The value water is perceived to have in the home largely depends on the function it is performing. Water for drinking and cooking is most highly valued as it is essential for sustaining life. Water for washing to ensure personal hygiene follows closely as next important, then water for washing-up and laundry making up the lower priorities. Finally “external water” used to water garden and wash cars is generally considered the most expendable use (Syme et al., 2004). It is not essential for life and is often very consumptive. In Perth, Australia it was found that 56% of total domestic water was used outside the house (*ibid*), hence hose pipe bans are the first precaution when reservoirs run low.

People have different priorities but for many people their gardens are an important contribution to their wellbeing. They can help to avoid stress, provide recreation as well as personal and societal identity (Syme et al., 2004, p. 122). This extension of one’s physiological home is an important factor and should not be overlooked. Water companies need to consider socio-demographic factors in their decisions. The concept of “social elasticity” needs to be built in to assess how much a loss of water for the garden would affect people’s lives (*ibid*, p. 127).

Water for irrigation is crucial in Australia to maintain a ‘green’ environment (Syme et al., 2004, p. 127). The Syme et al study began with the premise that the urban lifestyle is significantly contributed to by gardens and the activity of gardening. The data they gathered and the subsequent analysis supported this. It can be then concluded that since lifestyle, leisure and gardening appear to be interrelated, drought management and water restrictions can reasonably be assumed to damage people’s quality of life. If

droughts become prolonged or annual rainfall begins to fall year on year, the public it (is assumed) will realise this and want to take action to maintain their standard of living. An increase in the price of water would encourage more conservative use of water in the garden or a desire to accept other solutions. In the UK grey water recycling systems could become attractive to home owners if restrictions to water supplies threaten the aesthetic quality of a garden they value.

PREPAREDNESS TO BECOME INVOLVED AND INVEST

In the UK the surveys that have been done suggest that people are keen to save water and adopt the use of water efficient appliances, but are not prepared to pay very much to do so. It was found that despite the economic downturn 48% of households planning to buy a new home in the next three years would be willing to pay more for water-efficient features. However they are not prepared to pay very much, 19% would pay under £500, 14% between £501 to £1000, 6% between £1001 to £2500 and just 4% prepared to pay more than £2500 (Savills Research, 2009). The grey water systems currently on the market are typically around £5000 - £6000 per households, so unless the developers or the government are prepared to absorb the cost these systems are currently not feasible in the UK. The majority of potential new homebuyers (42%) like the idea of a water efficient home but will only pay about the same for their new home (Savills Research, 2009, p. 6).

The concept of water reuse has been widely accepted by communities in Australia. A major contributing factor to the widespread acceptance in Australia is likely to be that people can visible see a scarcity of water. Australia has now experienced a prolonged period of drought, so most of population are well aware of water issues. But still it seems they only want to become involved in saving water and invest themselves if they have too, i.e. to maintain their standard of living.

VALUE OF WATER ACCORDING TO PERCEIVED QUALITY

We can see in everyday life how individuals' value water differently based on their judgement of quality and source. Bought bottled water is a prime example of this, with tap water in the UK being treated to the very highest standards rationally there should not be a market for bottled water. However people still pay many times more for a product that is virtually the same, all be slight taste variations. It is because water bottled from a spring is perceived to be purer and therefore better for you. Grey water reuse in the home would therefore have to be charged at a different tariff and be used for functions people agreed did not need drinking quality water. Related to that is that people prefer their own waste to that of others, so if they have to use grey water they would rather use the grey water they generate than anonymous grey water (Jeffrey, 2003, p. 114). So from this assumption one could say people value their own

grey water more than that of others and like drinking water, the value of grey water varies depending on the source.

EVALUATION OF SERVICE

It could be argued that in the UK water customers take their supply for granted. For those in the industry this could be seen as a measure of trust and a badge of success. In terms of health, few people these days worry about the quality of their drinking water; according to the Drinking Water Inspectorate water quality is better than it has ever been (Drinking Water Inspectorate, 2002). In terms of interruptions and restrictions to supply water companies have come a long way since the early years of the 1990s post privatisation. Supplies are now more secure and investment is ongoing to ensure supply for the future. Hosepipe bans crop up every so often, the last ones in the UK were imposed because of two consecutive dry winters. The last restrictions were lifted over two years ago (Which, 2007) and the bans soon become forgotten as people return to their normal consumption patterns. So to conclude it could well be the case that consumers in the UK fail to fully value water because their service is too good. It is virtually always reliable, of a very high standard and compared to other commodities is relatively cheap. It is possible that not until one of these factors changes will people start to fully value water. It could be commented that it is water itself needs to define society; society will not change until the water resources available do.

2.4 Conclusions

This review of the literature has established that grey water recycling can help to achieve sustainable water resource management. Lightly contaminated water after relatively minor treatment can be used in the place of drinking water for many household non-potable functions (particularly for toilet flushing) to significantly reduced water consumption. This has a positive impact of the environment as a greater amount of water can remain in the environment because less needs to be abstracted. Grey water recycling systems can also enable water resources to meet a higher demand, for example a growing population. It has been used for many years in the USA to ensure water demand is met and now more recently in Singapore and Australia.

The challenges that have faced the implementation of grey water recycling systems in the past are generally not due to the practicalities; the engineering aspect of these systems is now well established. Water recycling systems have failed to get off the ground because of societal opposition and financial constraints. The public has health concerns about using a water supply that can be conceived to be dirty; the public can be reassured about the safety of the system and its advantages. However they will still

not accept something that is of a lower quality whichever way it is spun, if the public do not perceive there to be a need for it in the first place. If there are ongoing drought conditions then water scarcity is obvious to all, but otherwise the public might be difficult to convince that water recycling systems are needed. If people are not convinced they will not pay for it and even if they are the still high cost of the system many prohibit the investment.

So when considering the implementation of a grey water project it is crucial to consider its receptivity. How the grey water technology would be accepted and utilised and where the capability exists within the stakeholders for the project to succeed. If certain conditions exist in society it would make the public more likely to accept grey water recycling. The review of the literature explores some of these, first of them being a concern about the environment. Within a society there exist groups of people who remain strongly conscious of their impact of the environment, and if the environment is seen to degrade the size of this group will grow. People may well invest in water recycling for the environmental benefits it brings.

Water has a utility value as being used for basic human needs (drinking, cooking and washing etc) it can be used to fill swimming pools, water gardens and supply power showers for example. No one needs these things to live, they are extras that enrich people's life and individuals get pleasure from having them. If the price of mains water was to rise significantly the cost of having these luxuries may be prohibitive. People may then look for option to reduce their household mains water consumption and a grey water supply could be the solution. The theory is they would then value the drinking water far more than the grey water and be prepared to pay different rates accordingly. If water rates did not rise significantly but lower rainfall increased the occurrence of water restrictions (hose pipe bans for example) people may start to consider grey water recycling as a constant unrestricted supply. Being still wash your car and water the garden during a period of water restriction could be an attractive option to some people.

So this study will focus on establishing public opinion about the status of water in the environment and the likely impact of climate change. It will seek to establish how they value water, their water consumption habits and attitudes towards water conservation. Finally the survey implement will introduce grey water recycling as a concept and gather opinions on health and willingness to pay. It seems that there is a need for more social research into understanding how accepting the British public would be to water recycling. The only water recycling systems to operate domestically on a large scale are to be found outside of the UK and therefore the social research available on water recycling is not directly representative of a UK water user. As established in the case studies explored in this literature review, for a grey water

recycling system to succeed the social environment has to be accepting and the public attitudes and motivations need to inform the design of the system.

3 METHODOLOGY

3.1 Introduction

The aim of this study is to inform a business case for Cambridge Water as a water supplier to provide recycled water. It will generate information on house buyer attitudes towards the value of water and the value of domestic water recycling systems. The work will inform both Cambridge Water and housing developers about the feasibility of selling houses which possess a secondary non-potable supply derived from treated grey water.

The survey aimed to find out how people use water, what value they put on water and if they understand the constraints that could be put upon water supplies in the future. It attempts to understand whether the public are prepared to invest in the technology now to avoid a potential crisis in the future. So having identified the research area and formulated the research questions following a review of the literature, the next stage considered whether a social survey was appropriate. For this study it was decided that a social survey was the most suitable course of action to answer the research questions. Some research has been conducted into this area before but not a great deal. A literature based study would therefore have been reliant on case studies from overseas and the UK more broadly. In order to make accurate conclusions for this study it was necessary to collect our own primary data. This would ensure the data used was up to date and relevant to Cambridgeshire. The survey design and implementation followed the steps shown in Figure 3.1 below. This chapter will explain more fully the methodology of the survey.

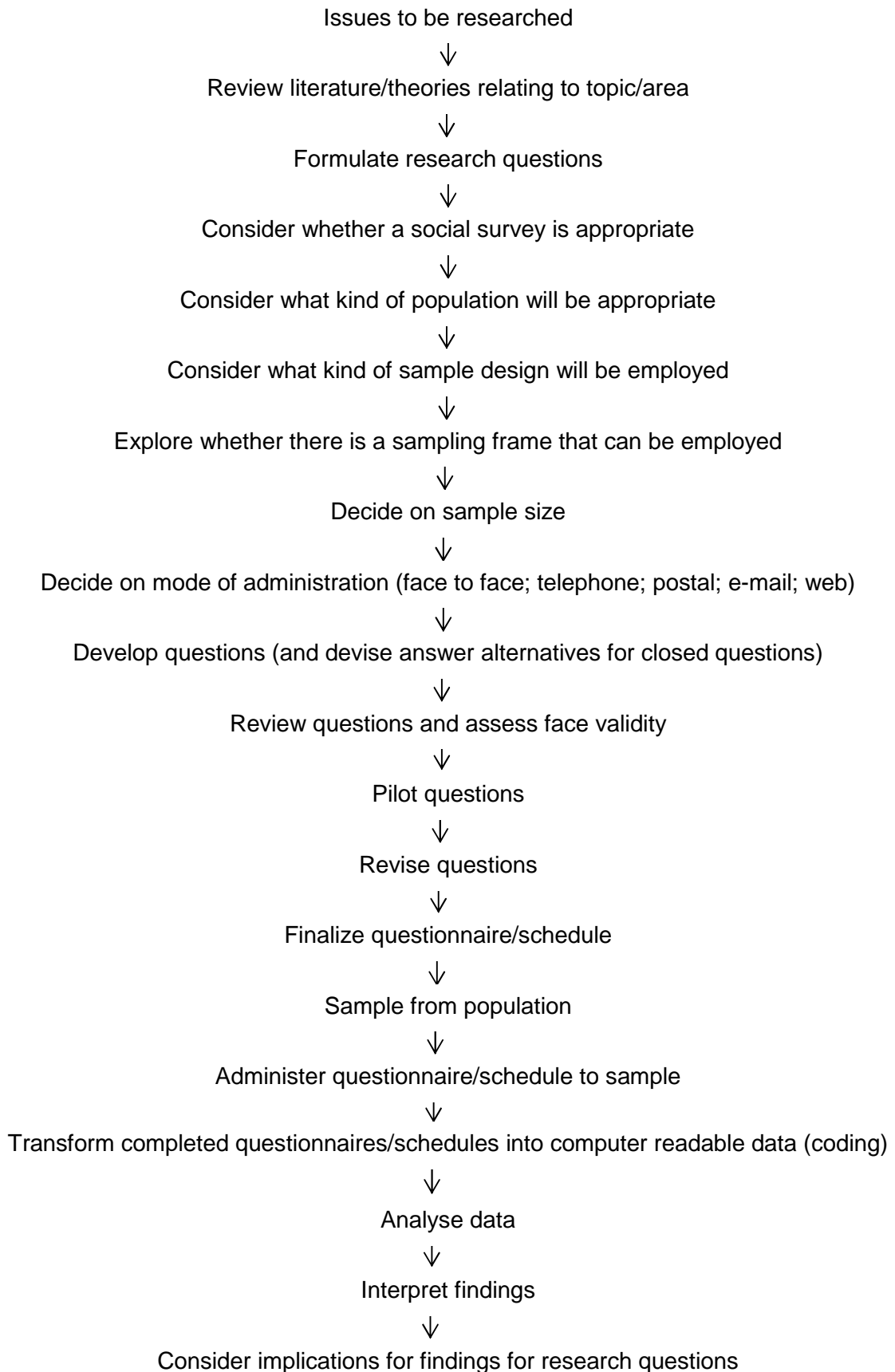


Figure 3.1: Procedure of the research

Source: Byrman, A. (2004), p. 85

3.2 Survey design

3.2.1 Method

A self-administered questionnaire was chosen as the survey instrument because it best served the purposes of this study. A self-completion questionnaire is generally cheaper to administer than an interview (Bryman, 2004, p.133). Although the printing and postal costs were not insignificant for this survey, the time and travel costs incurred to contact the same number of people would have been many times greater. Telephone interviews would have been less costly than face-to-face interviews but given the time constraints and manpower available this was not feasible. Self-completion questionnaires are the quickest way to reach a large number of people for the single researcher. A postal questionnaire also ensured that the details of Cambridge Water's customers remained confidential. Cambridge Water handled the printing and posting of the survey implement as well as receiving the responses.

The absence of interviewer effects is another advantage of self-completion questionnaires over structured interviews. It is not clear precisely what these effects are as they vary from study to study, but it is thought that interviewer characteristics influence response patterns. In particular there is a "tendency for people to be more likely to exhibit social desirability bias when an interviewer is present" (*ibid*, p.134). This could well have been the case with this study when probing customers' willingness to conserve water. Not having an interviewer asking the questions also removes any possible unwanted variability in the answers, for example asking the questions in a different way or different order (*ibid*). Finally a questionnaire received by post is convenient for the respondent, they can choose when and at what speed they fill it in.

3.2.2 Sample

New houses are the most suited to having a grey water supply. The additional piping and treatment works are difficult and costly to fit and site for existing homes. That is why this study focused on the views of customers who had recently moved into a newly built home. Ideally the sample for the survey would have been comprised of current buyers. This was not feasible to do, so the survey was conducted retrospectively and those customers having recently moved into a newly built home were targeted.

It was decided to include all Cambridge Water customers who moved in the last two years in the sample. It was found that 2000 of Cambridge Water's customers fitted this criterion. Cambridge Water has just over 100,000 customers so this figure represents nearly 2% of the customer base. Roughly from this number it was thought

a 10% response rate could be expected, generating a sample size of 200. This sampling method it was hoped would effectively gather the opinion of the type of people who buy a newly built home. The sample comes from across Cambridge Water's area of supply and it is hoped will include different types of properties with a mixture of socio-economic groups inhabiting them. This should mean the results will be relatively unbiased by local factors. The questionnaire asked questions about age, education and where they live. Comparing this information with census data it will be possible to determine whether the results are relevant for the general customer base. Although the group we are interested in is buyers of new homes so a close match is not essential.

3.2.3 Category of questions

In this questionnaire all but one of the questions used are closed. Closed questions were chosen because they are quicker for the respondent to complete, making it more likely they will return them. The data can also easily be input to a computer for analysis, saving time for the researcher (Gilbert, 2002, p. 92). This study asked people about water, everyone uses water and therefore everyone should have an opinion of it, however small. Questions are formulated as statements requesting answers on a four-point scale ranging from 'strongly agree' to 'strongly disagree'.

Another type of closed question used was ranking scales. They asked respondents to rank a number of items in order of importance. Typically respondents were presented with a list of four or five choices and asked to give the most important a value of 1 and the least important a value of 4/5. This type of question is useful in ascertaining the level of importance people ascribe to certain things, for example the actions they would take first to save water. The alternative to ranking scales is to have respondents tick the items that are important to them; but ranking scales remove the possibility of having people ticking all or most of the items

One open question was used in the questionnaire; it gave respondents the opportunity to freely express any objections they had to the use of water recycling. It allowed all possible objections to be collected and to make sure no possible reason for objection was overlooked. It also gives people who are unsure an opportunity to state their concerns. Respondents also have another opportunity to make comments at the end of the questionnaire. An open question at the start of a questionnaire can put people off responding so the open question was placed at number 18 of 21. Concerned about being too prescriptive with the questions, some selected question gave respondents space to enter their own answer. Although a comprehensive list was provided, it is important to include this choice, because many people for example may be saving water in a way not widely reported in the literature.

Not all of the questions would be applicable to all the respondents and so the questionnaire included filter questions. For example people without gardens and cars were directed around the questions that asked about washing and watering gardens. This was an important feature to build into the questionnaire because without it, respondents would become confused and probably annoyed being asked to answer questions that did not apply to them. Respondents with a garden and a car would be asked to answer the full 21 questions, whilst those without both a car and a garden had to answer 16 questions.

3.2.4 Questionnaire structure

The questionnaire was broken down into three constituent parts: water and climate, attitudes and actions and grey water recycling. The first section aimed to elicit the respondents' views on water availability, water consumption as well as anticipated climate change impacts. This is an important area to cover because people who are environmentally conscious are more likely to invest in technology that helps the environment. A recent survey found 48% of respondents thought saving water was beneficial for the environment (Savills Research, 2009, p. 2). Based on this finding it seems that there are sectors of society that would be prepared to invest in grey water recycling in order to help the environment. The second section investigated people's water use habits and their attitudes towards water conservation. It asked whether they thought people should try to save water and what specific actions they had taken (if any) to reduce their water consumption. The questionnaire then asked about external water usage, watering garden/vegetables, washing the car and the outside of the home. It requested respondents to state how important each activity is to them and how often they engaged in that activity.

The questionnaire focused on external use because if households use water outside regularly it is likely to make up a substantial percentage of their overall water consumption. They therefore would be most affected by water shortages if restrictions such as hose pipe bans were put in place. The hypothesis was that people who regularly use water externally are doing so to maintain something they value, a clean car, nice garden for example (Syme et al., 2004, p. 122). The theory is that these people would be willing to invest in grey water recycling to ensure there were no interruptions to their outdoor activities. After the external water use questions the respondents were asked what they would do in the future to save water and to give their preference of activities from a list. The final question of section asks if water efficiency was a factor in choosing their new home.

The third section probed people's opinions of water recycling and using treated grey water in their own home. It asked about whether they would worry about the safety

of the water, what they would be prepared to use it for and what would encourage them to adopt it use. Enquiring about willingness to pay, respondents were requested to say under what conditions they would invest in a grey water recycling system and whether they believed it should a compulsory feature of all new builds. The respondents were also given an open question in which to freely express any objections they would have to the use of recycled water. It was crucial to explain and ask questions about the practical use of grey water in the home. People may agree with grey water use in theory but can be subsequently put off by health or cost concerns for example. Health concerns have been in the past major barriers to the introduction of grey water recycling systems, so it was important to investigate what level of acceptance exists (Po et al., 2003, p. 17).

3.2.5 Question development

The development of the questions followed the steps laid out in Figure 3.1 at the start of this chapter. Once it had been decided that the mode of administration was to be a self-complete questionnaire, the question development began. To start with lists of potentially suitable questions were drawn from the literature.

Once a draft list of questions had been devised (including the answer alternatives for the closed questions), they were reviewed to ensure that would answer the research questions. At this stage questions were re-arranged into the sections they belonged and questions, it was felt would contribute little to the results, were removed. One such question asked the respondents about where they would prefer their source of grey water to come from. The options given included: their own shower/bath, their neighbours' showers/baths or a larger centralised system. It was decided to remove this question because virtually all the studies that covered this before show that people prefer to use their own grey water the most and an identifiable source the least. Since the answer to this question is well established in the literature there was no need to include it in this study.

The questionnaire was then piloted with colleagues at Cranfield and Cambridge Water staff. Individuals were asked to complete the questionnaire and comment on any problems they found doing so. Informed test respondents, Cranfield and Cambridge Water staff were also able to comment of the content of the questionnaire; whilst friends and family were more representative of a typical respondent. After receiving the feedback, the questions were revised and a copy was circulated for approval by all concerned parties. Final alterations were made before the finished questionnaire was signed off. Below in Table 3.1 is a breakdown of the questions, their origin and what modifications were made if they were existing questions.

Question	Reference	Comments
1	The Gallop Organisation (2009), <i>Flash Eurobarometer on water</i>	Slightly modified. Region changed and options taken out. Ranking.
2	<i>Eurobarometer on water</i>	Slightly modified. Region change, non-relevant options removed.
3	<i>Eurobarometer on water</i>	Modified. Definition between too much/too little. Strongly agree etc
4	Syme et al (2004) "Predicting and understanding home garden water use"	Modified. Options removed, boxes added, neutral position added.
5	<i>Eurobarometer on water</i>	Greatly modified. Focused on saving water, extra options. Tick boxes.
6	Syme et al (2004) "Predicting and..."	Modified. Changed from agreeing with to very important etc.
7	Original	
8	Original	
9	Original	
10	Original	
11	Original	
12	Original	
13	Original	
14	Original	
15	Original	Similar question in Pym (1999) "Grey water recycling..." MSc

		Thesis
16	Jeffrey & Jefferson (2003) "Public receptivity regarding 'in house' water recycling: results from a UK survey"	Slightly modified. Added meeting UK/EU standards.
17	Jeffrey & Jefferson (2003) "Public receptivity..."	Question original, inspiration taken to confirm hypothesis.
18	Potential concerns originally drawn from across the literature	Changed from closed to open questions
19	Original	
20	Speers et al (2003) "Setting and evaluating customer service standards"	Greatly modified. Created own scenarios, then changed to simpler scenario, a drought every...
21	Original	Took out reference to building codes
D1	<i>Eurobarometer on water</i>	Removed gender
D2	<i>Eurobarometer on water</i>	Took out occupation
D3	<i>Eurobarometer on water</i>	Put in Cambridge

Table 3.1: Question development

Some of the questions in the literature had been used in semi-structured interviews and so had originally had the option of further explanation. A good example of the development of a question would be Question 20. The idea was drawn from Speers et al (2003, p. 386), the original question can be seen in Appendix E. Using this format Question 20 was designed so that it found out under what scenarios people would be prepared to invest in grey water recycling. Like the Speers *et al* study it presented people with a hypothetical hardship and gave them the option of staying with the status quo, an immediate option or a full solution. For a version of that question in the development stages refer to Appendix E.

There was considerable discussion about this question with colleagues concerning its complexity for the respondents. But since what the question was asking was of the crux of the study's purpose it was left in the version that went to Cambridge Water for consultation. The result of that process was they too felt the question was too

complex and they also had concerns about alarming their customers. To avoid unduly worrying customers about increasing water bills or imminent water shortages the question evolved into the one that can be seen in the final questionnaire. Instead of the three scenarios the revised question presented the costs of the grey water system upfront; with this knowledge the respondents stated after how many years of consecutive drought there would be prepared to invest. The change in the format made the question easier to answer and the wording chosen did not imply in the same way a future threat.

3.3 Survey implementation

The questionnaire was sent out by post at the start of July asking customers to respond by the end of July. It would have been preferable to have had a longer field period (five to six weeks). Responses were still arriving after the cut off date for the competition, indicating some customers are concerned about water issues. However time constraints reduced it to a month. The time frame for the whole project was a short one and the printing took longer than expected. The questionnaire was accompanied by a cover letter and a pre-paid reply envelope addressed to Cambridge Water. The letter explained the purpose of the survey and that it was being conducted in conjunction with Cranfield University. My contact details as the researcher at Cranfield University and the email and phone number of the relevant contact at Cambridge Water were contained in the letter. Respondents were informed that if they had any questions about the survey to contact either myself or Cambridge Water. The accompanying letter also gave the date by which to return the questionnaire and outlined the procedure for entering the prize draw. Finally the letter explained that the research outcomes of the survey would be made publicly available to all Cambridge Water customers later in the year.

It was expected that there would be an immediate peak in the number of responses as people completed the questionnaire on receiving it and returned it soon after. This was the case and possibly the number received was influenced by the weather. The questionnaire reached the customers at the end of a very hot and dry week. It is likely this focused people's attention towards water issues and they were more willing to spend time filling out the questionnaire. As a result by the end of the first week of the field period the target of 200 responses had been achieved. There was to be a reminder sent half way through the field period. A second letter was prepared to accompany a replacement questionnaire; but having reached the target number of responses a decision was taken with Cambridge Water to not initiate a second mail out.

The survey included an incentive; respondents were offered the chance to be entered into a prize draw. There was one prize on offer; £250 worth of John Lewis vouchers for the first person drawn from the hat. Respondents were asked to supply their contact details (name, address, telephone number and email) at the end of the questionnaire on a detachable slip. This information was removed by Cambridge Water and entered into the draw, before the rest of the questionnaire was sent to Cranfield for analysis. The use of an incentive has been shown to increase the rate of response by 4 per cent (Dillman, 2007), and well exceeding the estimated response rate this survey has shown it to be a welcome addition. The idea for a prize draw was proposed by Cambridge Water and obtained ethical approval before the survey implementation.

The chance to be entered into a prize draw should hopefully ensure that a broad spectrum of customers reply, but one must bear in mind that many of the responses will be from people who are environmentally conscious. They may be responding primarily because they want to have an input on the debate rather than to enter the draw, so there will be over coverage of this sector of society in the results. For example if the results show that 80 per cent of new home owners are in favour of grey water recycling systems, the true figure is probably slightly less as many people who have no strong views on the matter will not respond.

3.4 Survey analysis

The questionnaire data was input into a spreadsheet; each questionnaire was attributed its own row and each question was given a column. The closed questions had answer alternatives and so the columns were split into the appropriate number of sub-columns. Where a tick had been entered into a box, a 1 was input in the relevant field. For the ranking questions the value of the rank was entered into the field, for example if concern about increased flooding was rank as second most important, a 2 was entered. The sum of each column for both the tick box and ranking question is an indication of the attitudes/actions. Different demographics that are of interest can be pulled from the database and comparisons made. In the same way the responses to two questions can be compared, for example willingness to pay and concern about the environment.

Many of the questionnaires returned had 'missing data'; this was when people fail to reply to a question either by accident or on purpose (Bryman, 2004, p. 220). When this was the case no value was entered. In order then to compare two questions with different numbers answers it was necessary to turn the sum of the columns into percentage values.

The processing of the data for the open question first included typing up all responses. The qualitative data could then be rearranged so that similar comments were grouped

together. From this it was possible to derive common objections to the use of recycled water; each of the objections was then given its own sub column in the main database. This meant that Question 18 became quantitative and could be analysed and compared in the same way as the rest of the questionnaire.

3.5 Ethical considerations

The study was approved by Cranfield's ethical research committee prior to its implementation. In the proposal presented to the ethics committee it was explained that a number of ethical issues had been considered and how they were addressed. Consent to the survey was implicit in the return of the instrument. In addition, the questionnaire provided a statement of consent at the beginning of the letter, asking respondents to confirm that they had understood the information provided and were willing to participate in the survey. Both the accompanying information letter as well as the introduction to the survey questionnaire clarified that the questionnaire completion was voluntary. The participants were made fully aware of the purpose of the study. Their type of involvement in the study as well as expected time commitments was clearly stated. It was emphasised that respondents were free to refrain from answering any question should they wish to do so. All participants were provided with Cranfield and Cambridge Water contacts to obtain further details for the study should they wish to discuss the study in more detail.

All data collected was anonymous to ensure that data cannot be linked to individuals. All participants were advised that the data they provided would be used for research purposes and that only the research team would have access to the raw data. As the data is anonymous there were no requirements for storing the data confidentially. Since the survey was collected through Cambridge Water the researcher had no access to names or contact details of the respondents. Personal data available to the researcher was limited to demographics (i.e. age, level of education, type of area they live). A prize draw was offered to increase the response rate. The accompanying letter clearly stated the terms and conditions for the prize draw. Respondents had to provide their name and address if they wanted to enter the prize draw. Cambridge Water kept this information upon receipt of the questionnaire; the questionnaires were then forwarded to the researcher for data processing and analysis. Therefore, personal details could not be connected to the questionnaire data.

An incentive in the form of a prize draw for a voucher was offered to motivate customers to respond to the survey. Incentives are frequently offered in survey research and are meant to encourage participation. Grant and Sugarman (2004) caution that incentives should not be used if the respondent is in any way dependent on the researcher or will consent to participate despite strongly disagreeing with the

study's intent or procedure simply because of the type or value of the. Under these circumstances incentives become a means of pressuring respondents into participating. None of these conditions were present in this study. The proposed research did not have any physical requirements and therefore the participants were not at risk. The risk of psychological harm or damage to career was considered but was decided to be unlikely.

4 RESULTS AND ANALYSIS

4.1 Introduction

This chapter presents the results of a postal survey of Cambridge Water customers. Customers who moved into a new build in the last two years were surveyed on their attitudes towards grey water recycling. In order to inform Cambridge Water as a water supplier of how receptive their customers would be to receiving a secondary supply of treated grey water for non-potable use.

Section 4.2 describes the characteristics of the respondents, followed by a presentation of the survey data. Reporting of results is structured along the main sections of the survey instrument.

4.2 Sample characteristics

The survey asked respondents for some general information about their background. From this data about age, educational attainment and where they live, it is possible to determine whether the respondents of the survey are representative of the broader population. This is done by comparing the survey data with data from the most recent census. The sample size was 2000 and 437 completed questionnaires came back, giving a response rate of 22%.

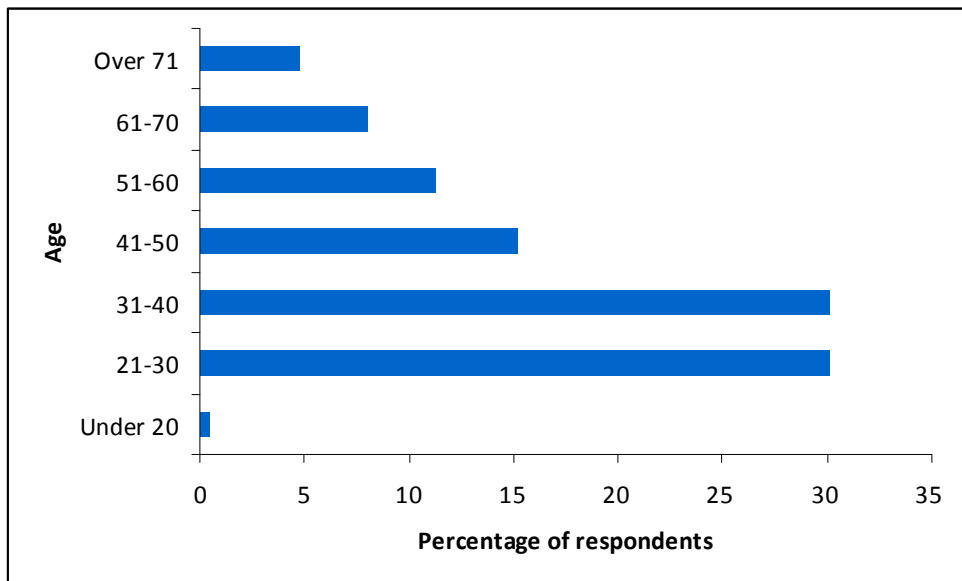


Figure 4.1: The age distribution of the respondents

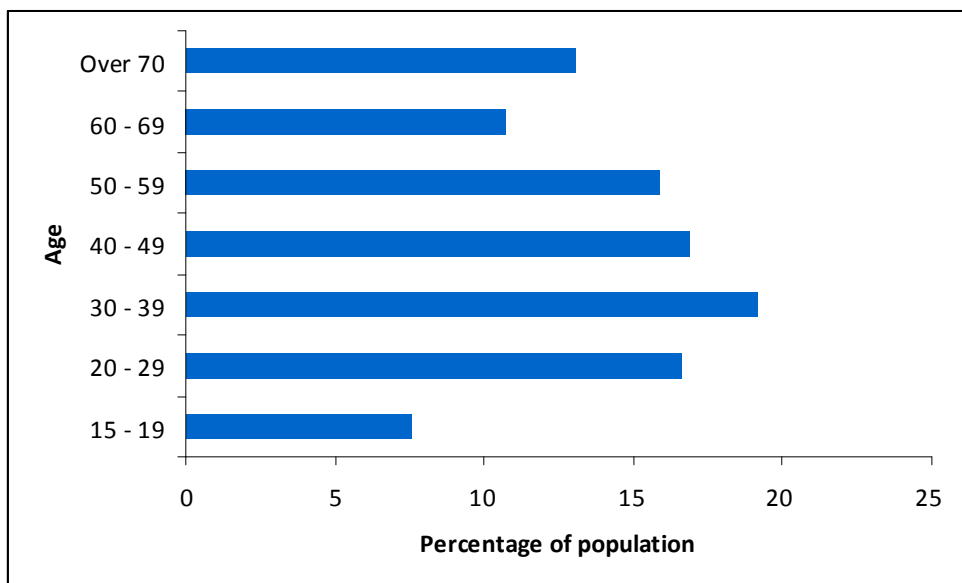


Figure 4.2: Age distribution in Cambridgeshire

Figure 4.1 displays the ages of the respondents to the survey. Approximately 30% of those that responded are in the 21 – 30 age bracket. The census data for Cambridgeshire, which can be seen in Figure 2 shows that this age range makes up 17% of the population. The 31 – 40 age range represents the second largest proportion of respondents at just less than 30%. The census data is a closer match for this age range, with this age range making up the largest percentage of the population and nearly 20%. Since the survey targeted recent buyers of new homes, not having a close match with the census data is not surprising as people with young or growing families typically buy new homes. The age ranges with the greatest deviation for the

census data are the over 70s and under 20s. Again, this is unsurprising since these groups are not expected to own new homes. It should be noted that it is not crucial that the age distribution of this survey closely matches the census data. The aim of the project was not to gauge the opinions of the general public, but rather home buyers in particular.

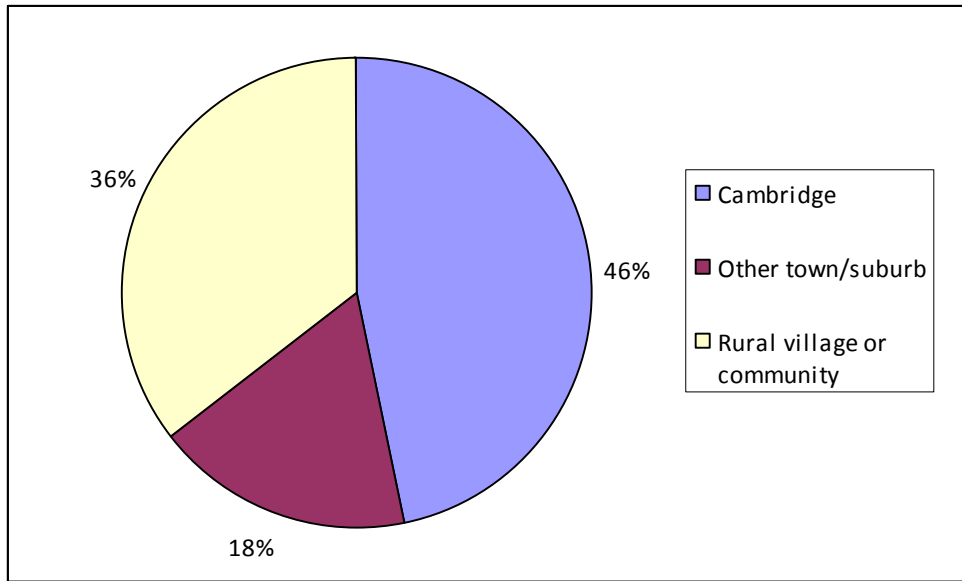


Figure 4.3: Respondents' area of residence

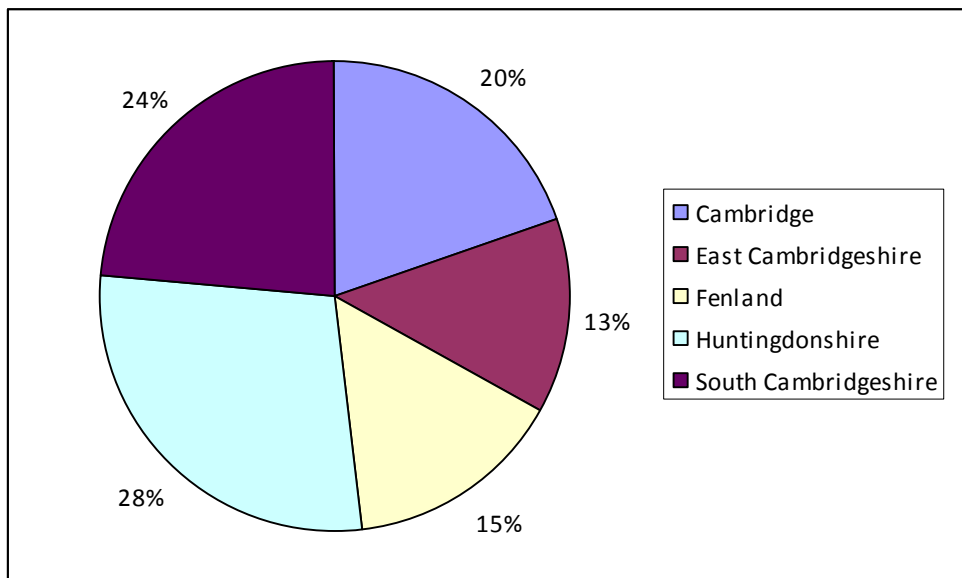


Figure 4.4: Population distribution in Cambridgeshire (Source: 2001 census)

Figure 4.3 shows that a large proportion (46%) of the respondents live in Cambridge; whereas Figure 4.4 which represents census data shows that just 20% of the population of Cambridgeshire live in Cambridge itself. Again this is not a great concern because the aim is to focus on house buyers, and it could well be the case that many of the new builds in the past two years have been in Cambridge.

Interestingly, 56% of respondents state to have obtained a university degree (see Figure 4.5). Cambridge as a city containing a large university could explain the high proportion of respondents with a degree or higher.

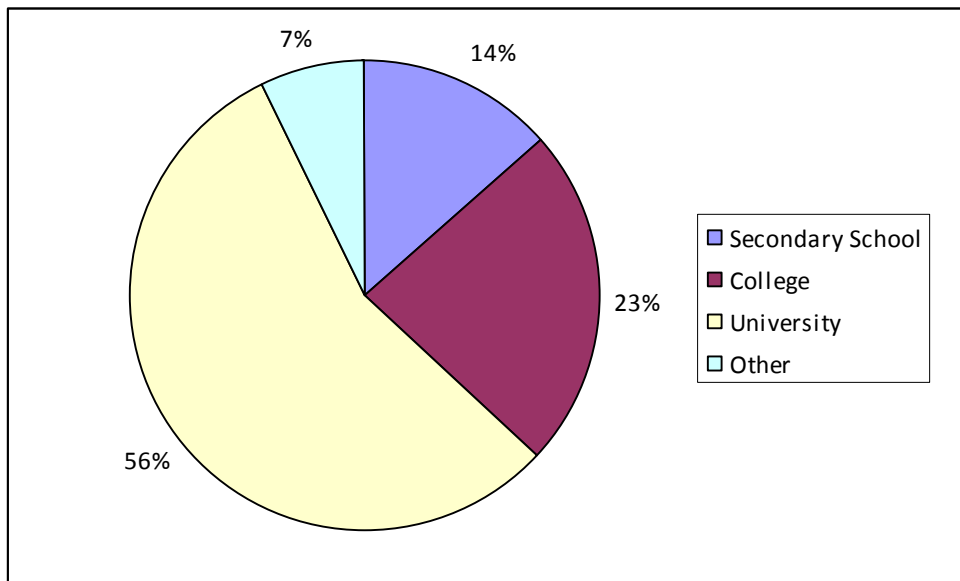


Figure 4.5: Education background of the respondents

However as shown in the Figures 4.6 the pattern is not to found in either Cambridge specifically or Cambridgeshire more widely.

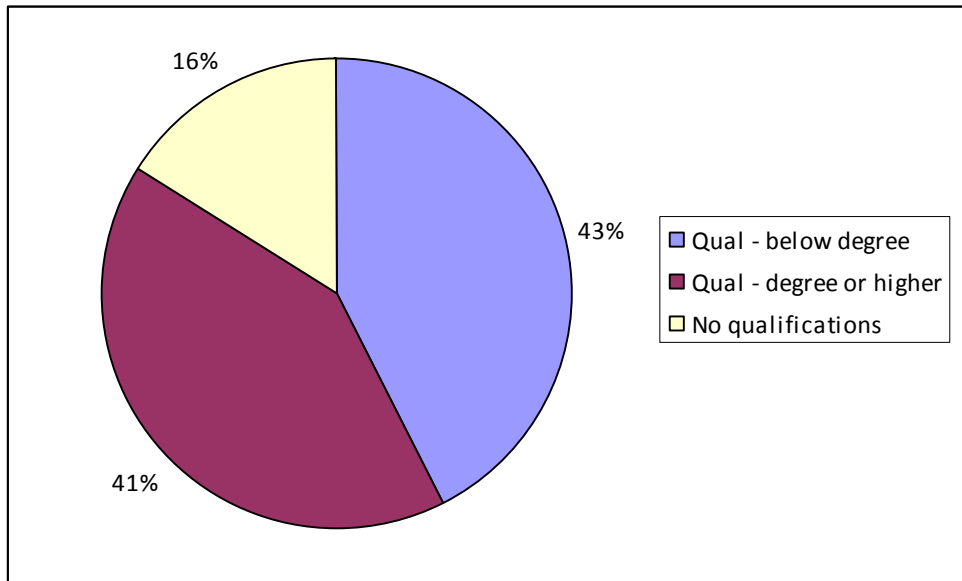


Figure 4.6: Population of Cambridge educational level (Source: 2001 census)

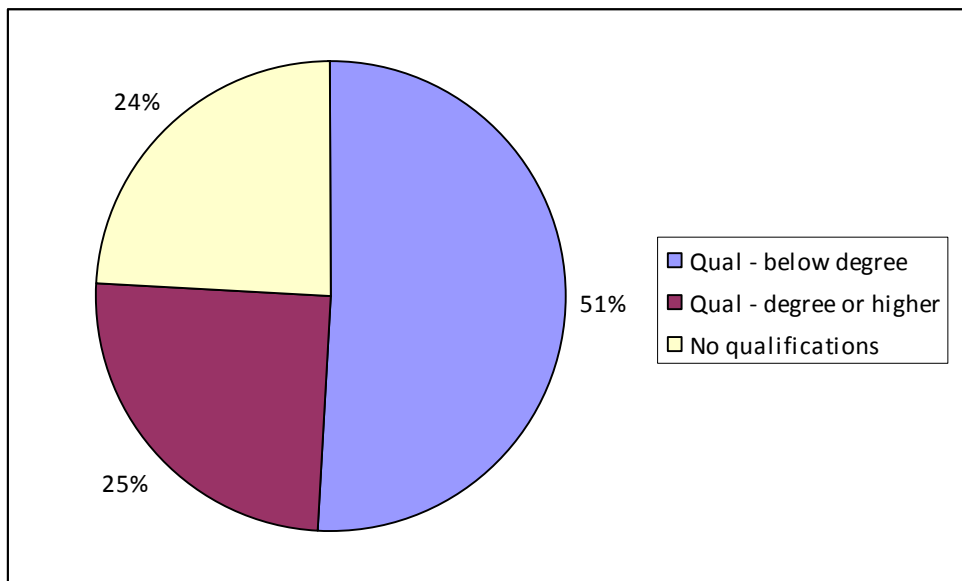


Figure 4.7: Population of Cambridgeshire educational level (Source: 2001 census)

An explanation of high number of graduates in the response group; could be that those with a higher educational attainment are more likely to be in a situation to buy a new house.

Moreover, the fact that the majority of the respondents had been through higher education could be the reason they responded. Having studied related topics people might already be engaged in the issue. The danger is that the 437 respondents might contain most if not all of those who are concerned about water conservation in the sample. Thus, giving the wrong impression that society as a whole is thinking about

the issue. If this was the case, it would still show 20% of home buyers are keen to see grey water systems adopted. However graduates were not the only respondents and the incentive that was offered will have encouraged people without a previous interest to respond. The results of the survey can therefore be broadly applied to population of Cambridge, and used more accurately to represent the attitudes of buyers of new homes.

4.3 Water and climate

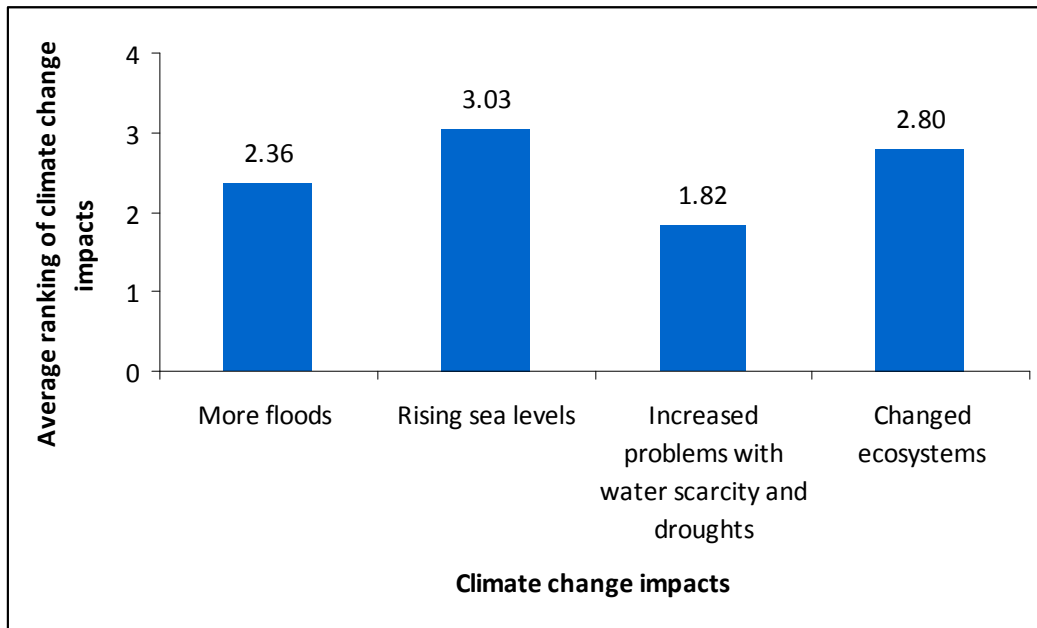


Figure 4.8: Average ranking of climate change impacts (Response scale – ‘1’ = most pressing, ‘4’ = least pressing)

Figure 4.8 displays the respondents’ perceptions of the most pressing climate change impacts. As the results illustrate, respondents are most worried about scarcity and droughts, closely followed by a concern about an increase of floods.

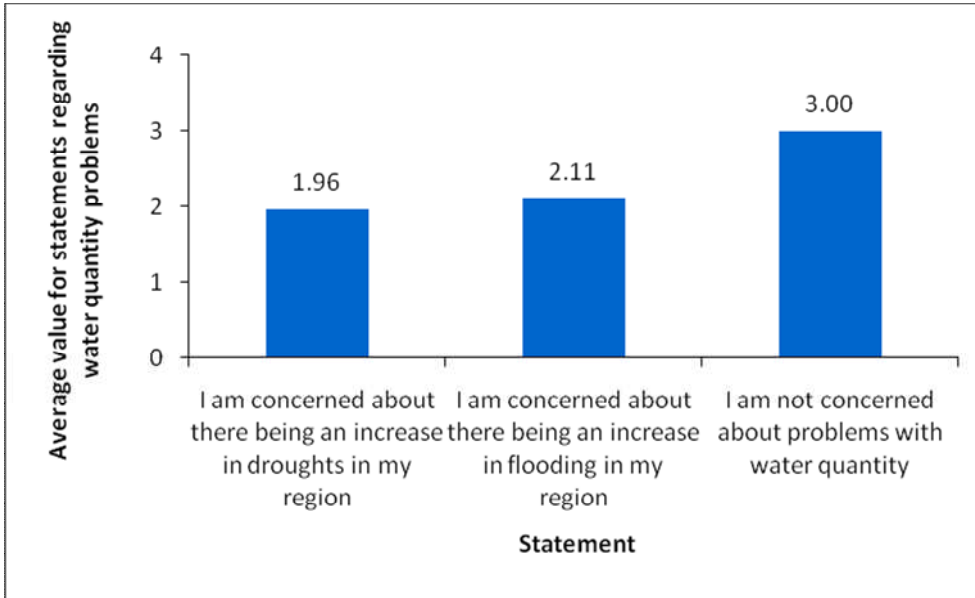


Figure 4.9: Responses to statements regarding water quantity problems (Values – ‘1’ = strongly agree, ‘2’ = agree, ‘3’ = disagree, ‘4’ = strongly disagree)

Figure 4.9 shows people’s responses to three statements concerning water quantity problems. The results confirm what was found from the previous question concerning climate change: the respondents on average agreed that they were concerned about extremes of weather.

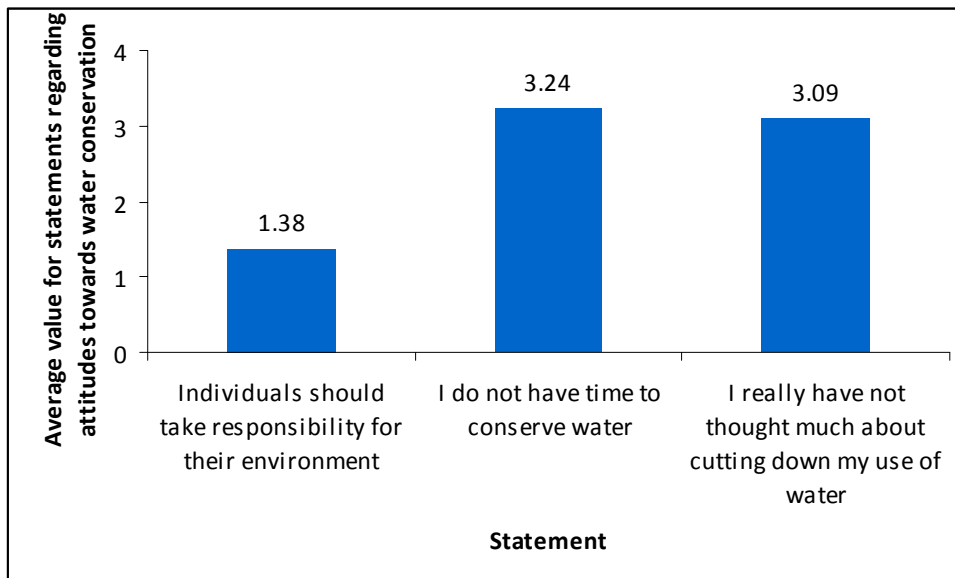


Figure 4.10: Responses to statements regarding attitudes towards water conservation (Values – ‘1’ = strongly agree, ‘2’ = agree, ‘3’ = disagree, ‘4’ = strongly disagree)

Figure 4.10 shows quite strongly that people believe they should look after the environment they live in, with the average sentiment falling between agree and

strongly agree for that statement. People have the time and have considered conserving water. The actions people have taken already to do this are shown below in Figure 4.11.

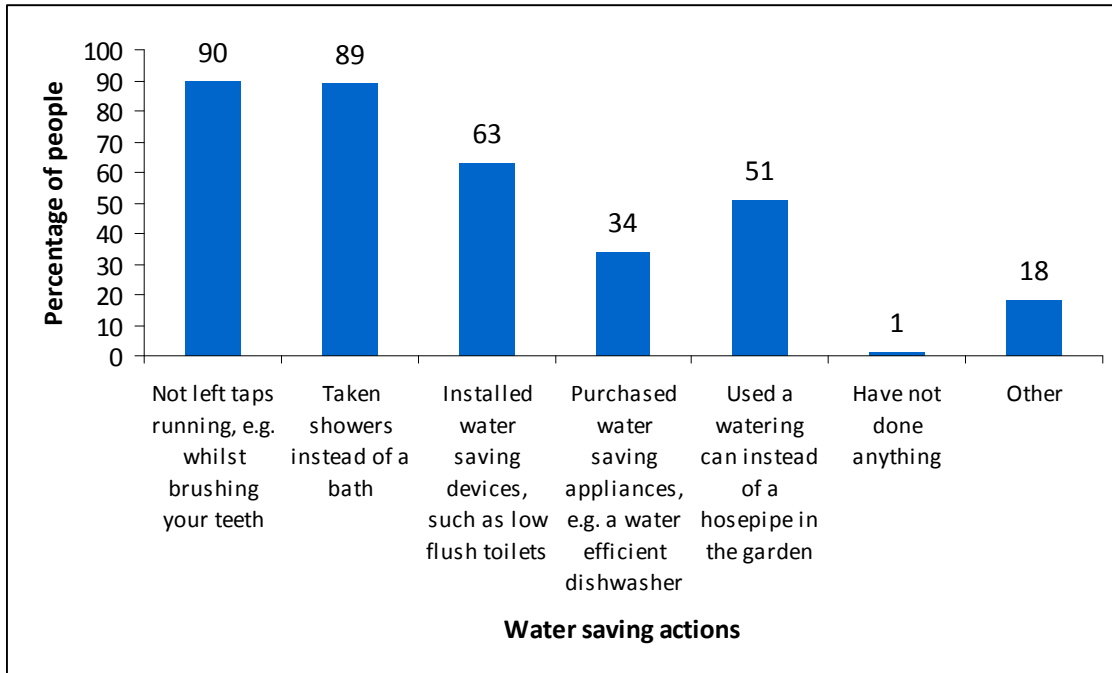


Figure 4.11: Percentage of people who have undertaken different water saving activities

Figure 4.11 reinforces the results presented in Figure 4.10 and illustrates that virtually all of the respondents engage in one or more actions to reduce their water usage. Most people (90%) are careful not to leave taps running and have taken showers instead of a baths. But of more interest are the 63% of people who have installed water saving devices, and the 34% who have chosen to purchase water efficient appliances. The proportion of people who have so far taken no action at all is marginal.

4.4 Attitudes and actions

Customers were asked to rank different sectors (domestic, industry, agriculture and tourism) according to their water consumption. Interestingly, Figure 4.12 shows that respondents thought that the domestic, industrial and agricultural sectors all had a similar impact on water availability. Only the tourism industry was perceived to have comparatively lower water consumption.

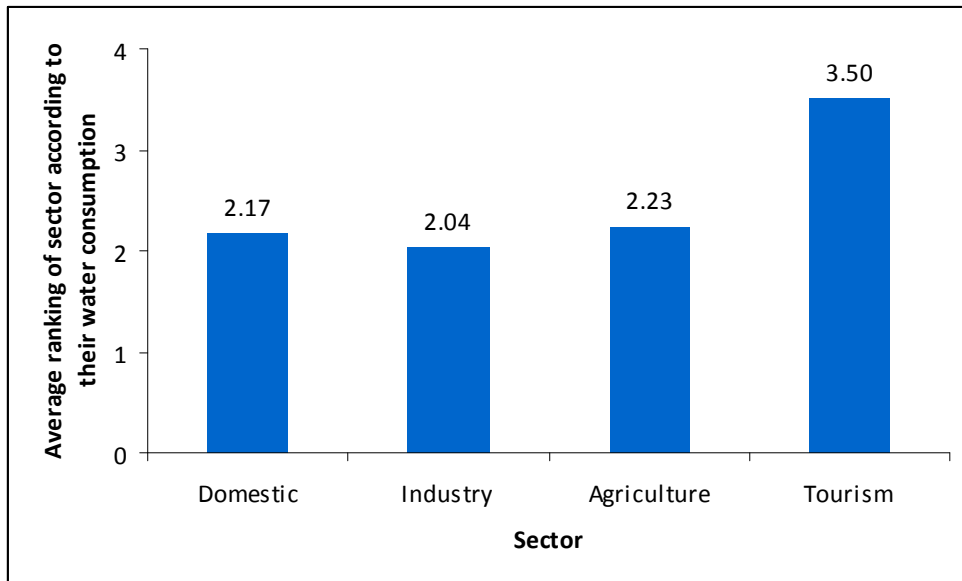


Figure 4.12: Average ranking of sector according to their water consumption (Response scale – ‘1’ = most consumptive, ‘4’ = least consumptive)

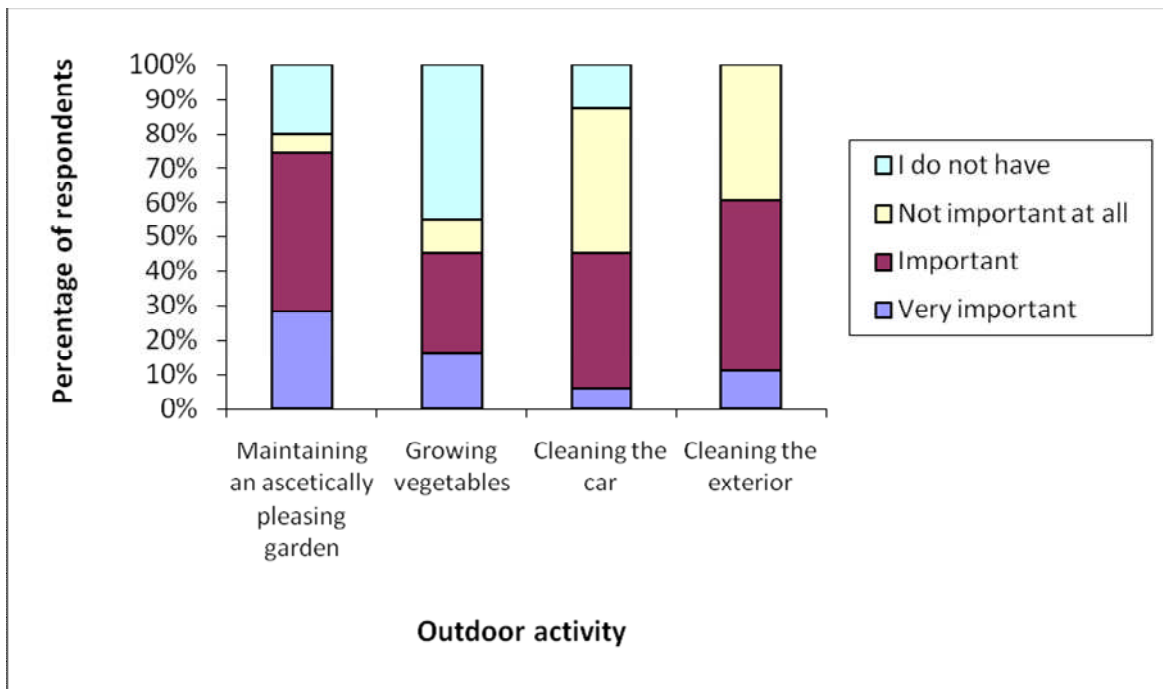


Figure 4.13: Relative importance of external uses of water

Figure 4.13 shows that when compared to other activities such as growing vegetables, cleaning the car or the house exterior; having a pleasant garden to look at is the most important outdoor activity to the homeowner; 74% of respondents consider it to be very important to them. Cleaning the exterior is the second most important activity with 61% of respondents stating it was important to them. However like the importance of having a clean car there are a large proportion of people to whom this

activity is not important at all. In the case of having a clean car the respondents are roughly split down the middle, with 40% stating it was important and a similar amount stating the opposite.

To further determine which activities are priorities for the sample, they were asked to rank different water saving options.

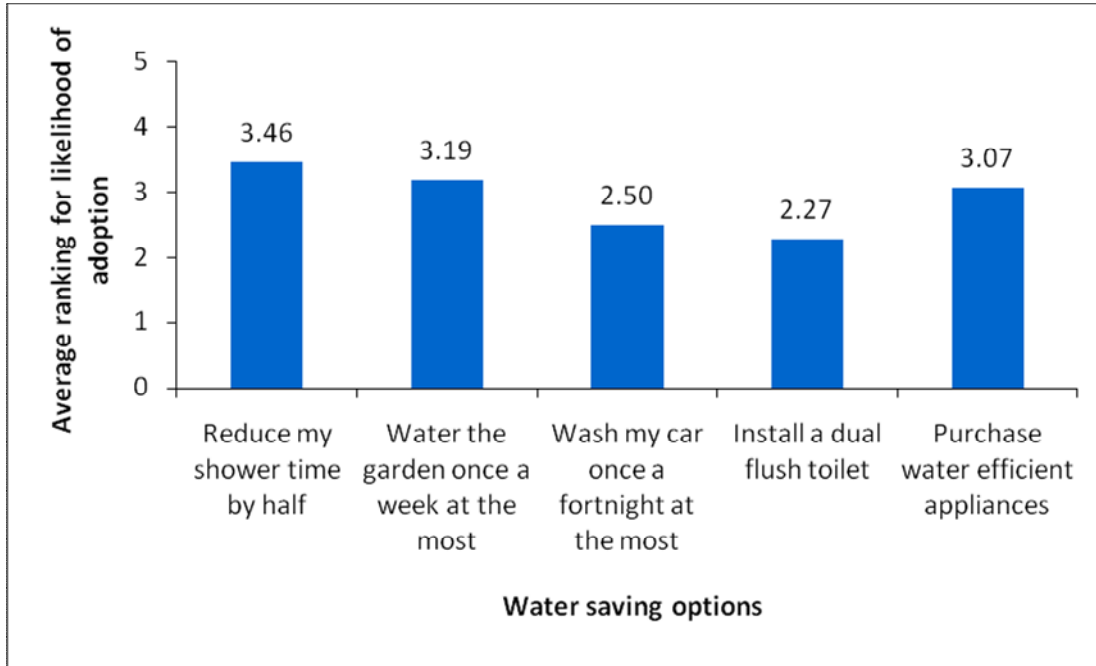


Figure 4.14: Average ranking for likelihood of adoption of water saving techniques (1 = most likely to do, 5 = least likely to do)

Figure 4.14 illustrates that respondents would be likely to give up washing their car; confirming that people prefer their garden over their car for example. The other options respondents were most prepared to invest in, were installing dual flush toilets and other water efficient appliances. This findings highlight that respondents are more prepared to invest in technologies rather than make compromises elsewhere, such as in the garden or shower.

4.5 Grey water recycling

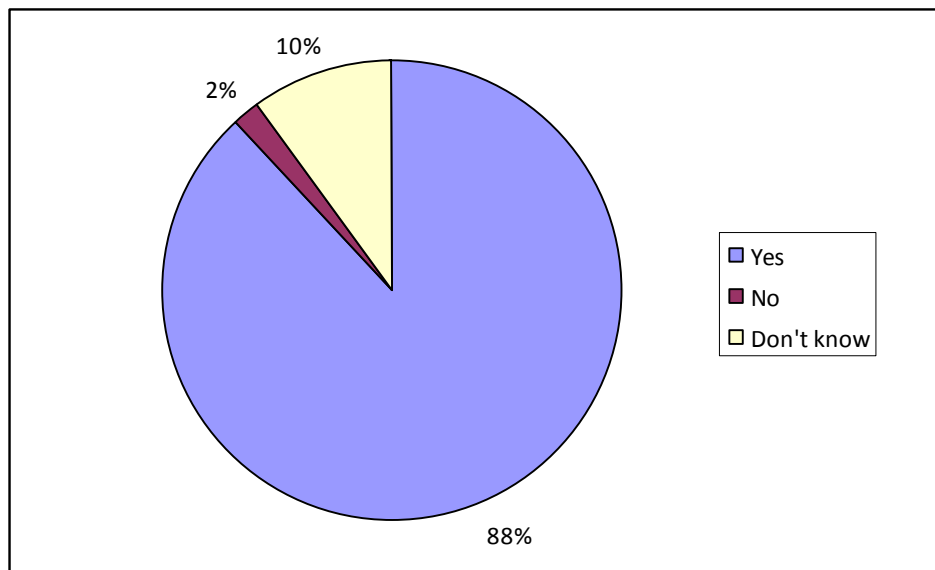


Figure 4.15: Percentage of people willing to use recycled water

Figure 4.15 clearly shows that the majority (88%) of respondents would be willing to use recycled grey water. It is important to note that this was on the proviso that the grey water was guaranteed to be safe; 10% of the respondents stated that they were not sure that they would be willing to use recycled water.

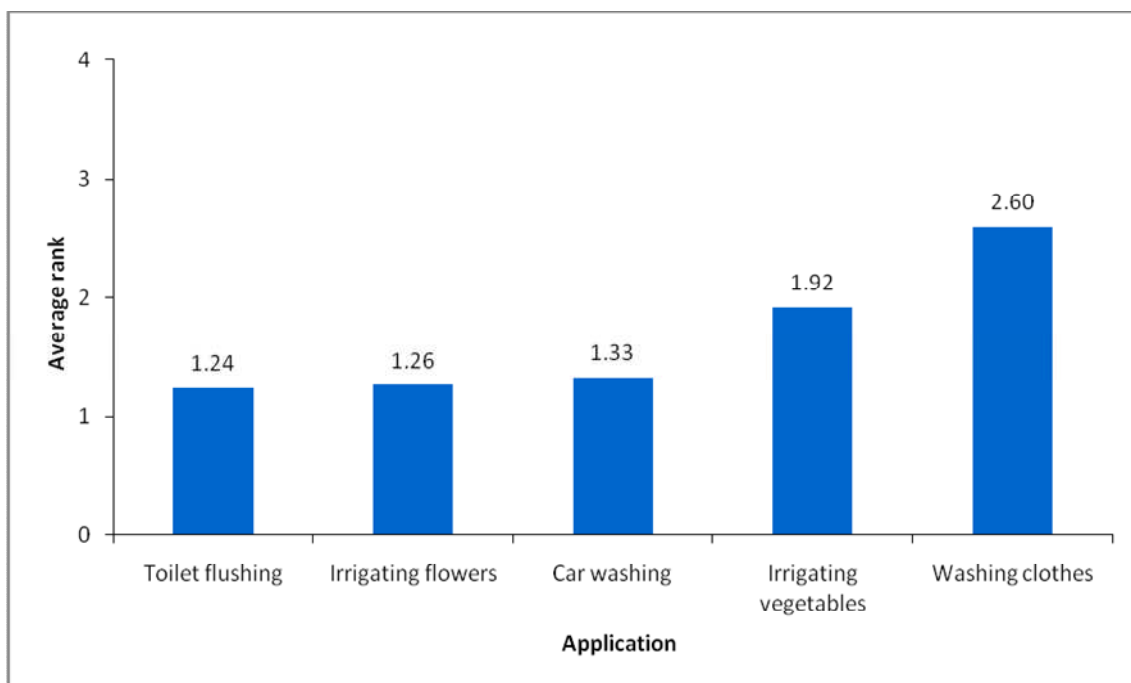


Figure 4.16: Extent to which respondents feel comfortable using grey water for different applications ('1' = very comfortable, '2' = comfortable, '3' = uncomfortable, '4' = very uncomfortable)

It is clear from Figure 4.16 that people are comfortable with the idea of using grey water for toilet flushing, irrigating flowers and car washing. These are all activities with limited human contact and the positive response is weaker for more intimate uses. On average respondents are still comfortable irrigating vegetables with grey water, but not to the same extent as the other non-intimate uses. The most unpopular use of recycled grey water was using it for washing clothes; many respondents were uncomfortable with this idea.

Question 18 was an open question and gave respondents the opportunity to freely express their objections or concerns regarding grey water use.

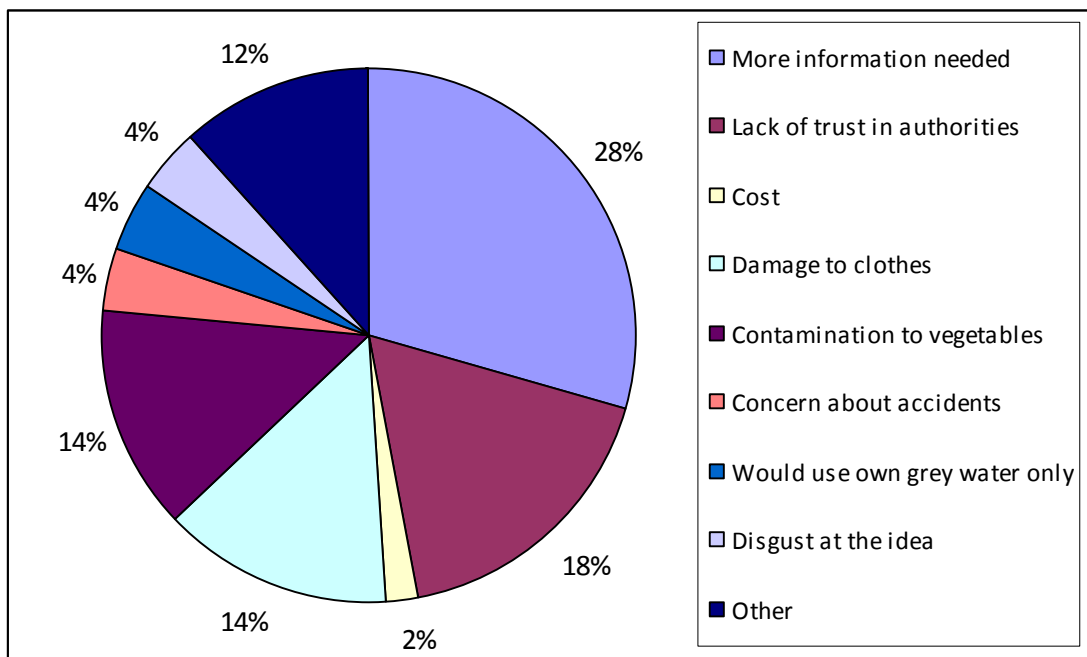


Figure 4.17: Reasons for objection to recycled water

Out of a total of 437 respondents eight people completely objected to the use of recycled water, and 41 stated they had reservations about particular issues. There were 53 people who made a comment for Question 18, meaning most if not all of those people gave their reasons for their stance. Those 53 comments were coded and grouped together to be quantified with similar comments. It can be seen from the chart that a lack of information is the main barrier preventing respondents to clearly committing to the use recycled grey water.

Figure 4.18 shows that 96% of the respondents are willing to invest in a grey water recycling system at some point. But a drought may have to occur as frequently as every year to persuade them to invest. The results show that for 63% of the respondents would be willing to invest if there was a drought every two years or more

frequently; meaning droughts would have to occur rather frequently before people became willing to pay for grey water recycling.

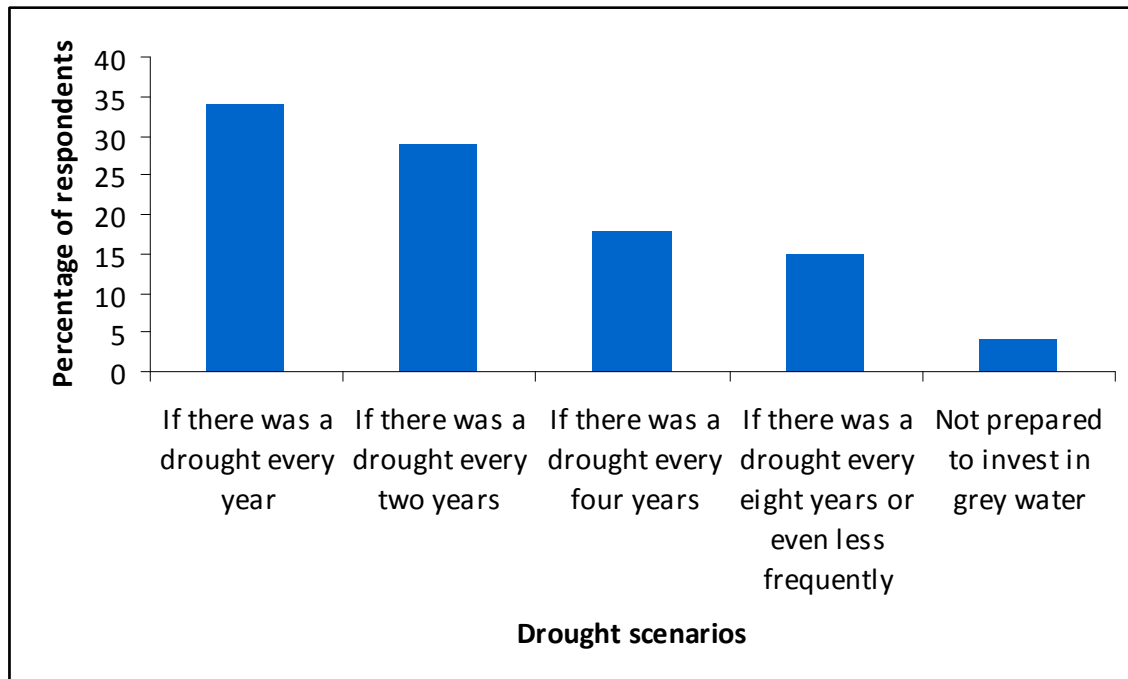


Figure 4.18: Willingness to pay for a grey water recycling system under different drought scenarios

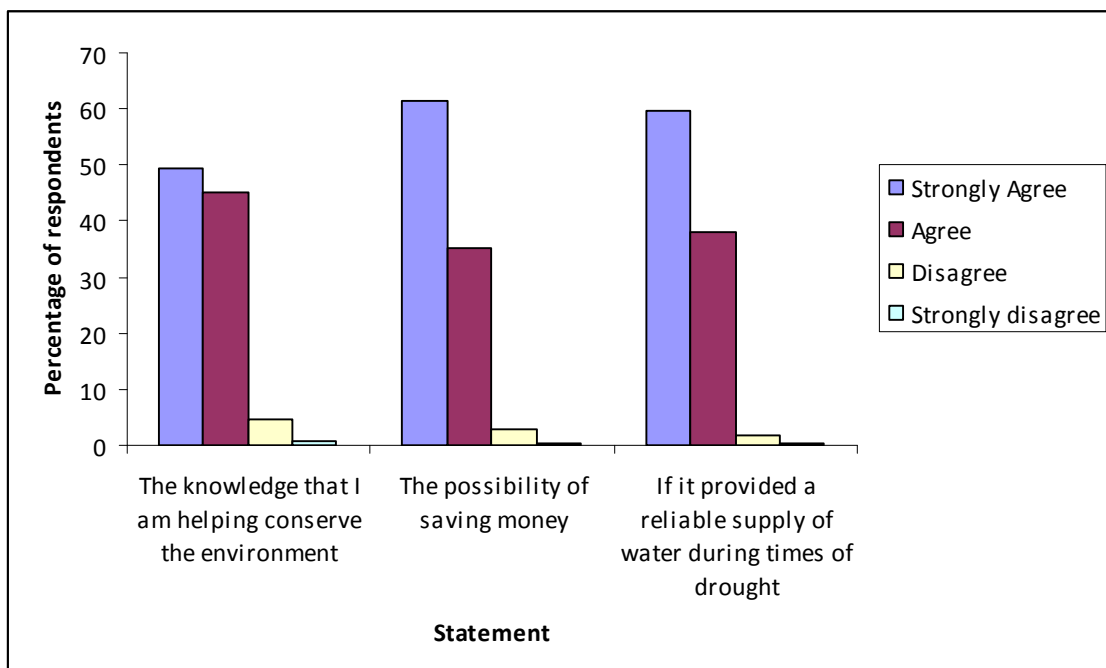


Figure 4.19: Reason which would motivate respondents to use grey water

Figures 4.19 illustrates that the respondents broadly agreed or strongly agreed with all of the statements; it would appear that a financial benefit and reliability of supply are of greater importance than the environment for the respondents. The possibility to save money by using less potable water is an attractive reason to adopt grey water use; and interestingly also is the chance to have an unrestricted water supply at times of water scarcity.

4.6 Cross comparisons

Table 4.1 below shows a comparison made between how important people say their gardens are to them, and the conditions under which they would be prepared to invest in a grey water recycling system. This was done because to establish whether there is a link between these factors and thereby answer the research question. Respondents were informed of the cost of a grey water system and then asked how frequently droughts would have to occur before they would invest. It was thought that respondents who value their garden highly would be prepared to invest in recycled water even if droughts were infrequent. However this was not found to be the case with the value of the garden not seeming to influence their willingness to invest. The cross comparisons for the other external uses also showed neither the value of having a clean car, watering vegetables or washing the outside of the home correlated with a willingness to invest. The tables for these cross comparisons can be found in the appendices.

Period of drought before investment	Garden importance			
	Very important	Important	Not important at all	I do not have a garden
Every 8+ yrs	10.78%	15.65%	14.24%	21.94%
Every 4 yrs	20.48%	14.79%	14.08%	11.19%
Every 2 yrs	30.25%	16.79%	23.14%	7.92%
Every year	35.46%	48.78%	43.61%	42.89%
Not prepared to invest	3.02%	4.00%	4.93%	16.06%
Grand Total	100.00%	100.00%	100.00%	100.00%

Table 4.1: Cross comparison between willingness to pay and garden importance

Cross comparisons are also used to verify some of the answers respondents gave. The questions about frequency of water use were also of use to verify the answers given for their corresponding activity. For example it follows that those people who stated that having a clean car was important should also state that they wash their car

frequently. The cross tabulation below displays the results for regularity of garden watering compared with stated importance.

Garden Importance	Watering frequency				Grand Total
	More than once a week	Once a week	Once a fortnight	Once a month or less	
Very important	45.54%	25.00%	9.82%	19.64%	100.00%
Important	34.07%	19.23%	13.19%	33.52%	100.00%
Not important at all	13.64%	18.18%	0.00%	68.18%	100.00%
Grand Total	36.71%	21.20%	11.08%	31.01%	100.00%

Table 4.2: Cross comparison between garden importance and watering frequency

Table 4.2 reveals that there is a link between importance and watering frequency as expected. It shows that 68% of respondents who rate gardens as little importance also indicate that they very rarely water their garden. Conversely, respondents who value their garden highly also tend to water it more than once a week. For the other outdoor activities, similar patterns were found, implying that the data generated by the external use questions can be considered to be reliable.

5 DISCUSSION

Research questions were formulated to achieve the stated aim, which is to inform Cambridge Water as a water supplier of how receptive their customers would be to receiving a secondary supply of treated grey water for non-potable use.

In this chapter those questions will be answered informing the conclusion. The research questions are:

- Do homeowners believe it is their responsibility to act on their environmental concerns?
- Would the desire to preserve outdoor water use persuade people to invest in grey water recycling?
- Is the concept and practicalities of using recycled water acceptable for homeowners?

This section will be organised around the research questions and follow the structure shown above.

5.1 Water and climate

This section of the questionnaire aimed to find out whether homeowners believe it is their responsibility to act on their environmental concerns. The questions about the environment were focused on water, with homeowners being asked to what extent they value water, and whether they anticipate problems of supply in the future. It is important to know what the customer's attitudes towards water are. Whether they simply regard it as a commodity to be bought and sold; with supply and demand governing its management or whether they thought it was more of a universal resource, with everyone being responsible for its management.

The results have shown that the respondents are most concerned about increasing problems with water scarcity and droughts. However this is closely followed by a concern about floods becoming more frequent, so the respondents to this survey are worried about extremes of weather in the future. They anticipate that in the future there will be more occasions when there is too much and too little water.

The questions about water quantity problems verify what was found from questions concerning climate change; the respondents on average agreed that they were concerned about extremes of weather. This question unlike the climate change question gave the respondents the chance to agree with the statement that they were not concerned about water quantity problems. In line with the other findings most people did not agree with this statement.

Customers thought domestic, industry and agriculture all had a similar level of water consumption. This would maybe suggest people were not sure about the relative level of water consumption of each sector (apart from tourism that was consistently ranked last). What is interesting from the data is that domestic consumption has on average been given roughly the same score by homeowners as industry and agriculture; signalling that homeowners consider homes to be a major water user.

People believe they should look after the environment they live in, with the average sentiment falling between agree and strongly agree for that statement. The respondents recognised that they use a lot of water in the home and people are prepared to take responsibility for the environment. So from this it could be deduced that the public would be prepared to cut their water consumption if it was harming the environment. The results have shown that in fact people are already dedicating the time and energy to conserve water in the home.

Virtually all of the respondents engage in one or more actions to reduce their water usage. Most people have done the obvious options; being careful not to leave taps running and have taken a shower instead of a bath. But of more interest are the people who have installed water saving devices, and purchased water efficient appliances. These results show there are many people who have already gone the extra step, and invested in water saving technology to further conserve water. This is encouraging when considering whether people will invest in grey water recycling technology.

The results the survey has produced show that people do value water. They recognise that their personal usage has an impact to overall sustainability of water resources. They are prepared to act individually to do their bit to help the environment, and they have shown that they are already taking steps to save water. People want to take action now, to have an immediate effect and to mitigate the effect of climate change, which people believe will bring changes for the water resources. In the 2003 UK study by Jeffrey just half of the people surveyed thought rainfall levels were decreasing, and most thought it rained enough to prevent any problems with water supply. In this study 80% of the respondents agreed that they were concerned about water scarcity and droughts. This shows an increased concern about water scarcity since the 2003 study. This study also found that a similar percentage (79%) disagreed that they were not concerned about problems of water quantity. This however covers an excess of water as well and the results showed people were also concerned about flooding. So it seems the respondents are concerned about extremes of weather, with people expecting increasing periods of water scarcity and floods in the future.

5.2 Attitudes and actions

The second research question aimed to find out whether a desire to preserve outdoor water use would persuade people to invest in grey water recycling. The survey therefore had to find out what applications are most important to people, and questions were asked about external water use habits. There was a desire to generate this information because grey water is most applicable for use outside the home. Recycled grey water could be used for nearly all applications outside the home, where currently potable water is used. In addition to this, restrictions are often placed first on external water when there is a shortage of water. The UK water customers have experience of this during years of low rainfall, which have caused hose pipe bans to be imposed. It was thought that people may see the value in having a grey water recycling system, because it would enable them to preserve their outdoor activities at times of water shortages.

People consider having a pleasant garden to look at to be the most important outdoor activity to the homeowner. Cleaning the exterior is the second most important activity. However like the importance of having a clean car there are a large proportion of people to whom this activity is not important at all. In the case of having a clean car the respondents are roughly split down the middle. Whilst these activities may be important to people they have little relevance to this study unless the activity is conducted with relative frequency. For example if one was to encourage the adoption of grey water recycling systems by presenting the range of outdoor activities it could be used for; it would be unwise to present exterior washing as a prime example. This is because people do this activity infrequently, 66% stated that they do this twice a year or less.

The questions about frequency of water use were also of use to verify the answers given for their corresponding activity. For example those people who stated that having a clean car was important should also state that they wash their car frequently. The cross comparisons revealed that there is a link between the importance and water use frequency as expected. These patterns imply that the data generated by the external use questions can be considered to be reliable.

Respondents stated that they would give up washing their car rather than showering less or reducing the amount they water the garden. This further confirms gardening as the most importance outdoor activity. The unwillingness to compromise on the shower time also confirms what is found in the literature. People are unwilling to compromise on their personal hygiene; hence why it was ranked as the least likely option in this survey. The most likely option for the respondents was to invest in a dual flush toilet, and ranked third was the option to purchase other water efficient appliances. The high ranking of these investment options by the respondents shows they would be prepared give up some activities; but then would rather invest in technology than make further sacrifices. The technologies offered for adoption were dual flush toilets and water efficient appliances. These are relatively low cost and easy to install compared to a grey water recycling system. In order to answer the research question, it is necessary to explore whether that willingness to invest in water saving technologies extends to grey water recycling systems.

A comparison was made between the importance people assign to their outdoor activities, and the conditions under which they would be prepared to invest in a grey water recycling system. Respondents were informed of the cost of a grey water system and then asked how frequently they would have to be affected by droughts before they would invest. A decision to invest if droughts occur on average every eight or more years is therefore the greatest commitment to grey water recycling.

Respondents who chose to invest under these conditions would have an advantage over conventional water supplies every eight years or more infrequently.

Grey water equipped houses would have the advantage that they would be able to freely use water external, at a time of water restrictions. The assumption being then that people who value their outdoor activities would not want to suffer a restriction in water supply. Even if that restriction on external use was as infrequent as every eight years; whereas someone who was not as concerned about their garden, might accept the occasional browning of their garden during times of drought.

The cross comparisons have suggested this relationship is not present, the tables show that there is very little if any link between the importance of an outdoor activity and willingness to invest. The cross comparison tables can be found in the appendices. However despite the lack of a relationship, 96% of the respondents are still willing to invest in a grey water recycling system at some point. The results show that for 63% of the respondents there would have to be drought every two years or more frequently before they would consider investing. This means droughts would have to occur rather frequently before people became willing to pay for grey water recycling.

The questionnaire design may have skewed where the true average value of willingness to pay should lie for the average homeowners. Presently the average drought frequency before investment is approximately every two years. The order of the listed scenarios on the questionnaire started droughts at their most frequent, with options for less frequency down the page. If the order had been reversed starting with the 'eight years or less option', the respondents may have more clearly understood what was being asked. The true average drought frequency before investment may lie closer to four years rather than two. This is based on the positive attitude towards grey water throughout the rest of the questionnaire. If the question had been structured differently, it is possible that a relationship between the importance of outdoor water use and willingness to pay could have been established. The willingness of 96% of respondents to invest under the drought scenarios given still suggests they see value in grey water, and a potential relationship still exists.

The respondents broadly agreed or strongly agreed with all three reasons to accept grey water systems. It would appear that a financial benefit and reliability of supply are of greater importance than the environment for the respondents. The possibility to save money by using less potable water is an attractive reason to adopt grey water use. However a slightly more attractive proposition is the chance to have an unrestricted water supply at times of water scarcity. This result may be related to home owners being familiar with past water restrictions and wanting to preserve their outdoor activities. This result supports the assumption that people would invest to

ensure their standard of living is maintained; but as mentioned earlier this link is tenuous because the other comparisons made are inconclusive.

Water is important to many people for outdoor use and those people consume water frequently for their external activities. There is no apparent link between the degree of importance people hold for outdoor activities and willingness to invest. However 96% of the respondents said they would invest given the different drought scenarios. However for a large proportion of the respondents droughts would have to be relatively frequent before they would be prepared to invest. This correlates with the Savills Research conducted this year that found that homebuyers like the idea of water efficient home, but will only pay about the same for their new homes. The Australian case studies in the literature review show that people are prepared to invest in technology when droughts are common. This was reflected in this study, respondents strongly agreed that the ability of the recycling system to provide a reliable supply during times of drought would encourage its adoption for them. This outcome means the idea that people would invest to maintain outdoor activities cannot be discounted at this stage. However the climate may have to get drier before people are prepared to invest in grey water recycling systems.

5.3 Grey water recycling

The latter part of the questionnaire focused on whether the concept and practicalities of using recycled water would actually be acceptable for homeowners. Considering 96% of the respondents are prepared to invest in a grey water recycling system, there is obviously a good level of support for grey water. But it is important to go further and investigate whether grey water would still be acceptable once the realities had been considered; for example health concerns. This research area focused on what functions people would be prepared to use the recycled water for, if in fact they found its use acceptable.

The majority (88%) of the sample would be willing to use recycled grey water. It is important to note that this was on the proviso that the grey water was guaranteed to be safe; 10% of the respondents stated that they were not sure. This is a similar result to the 2003 survey from the literature by Jeffrey, which found 89% of respondents would have no objection to the concept as long as it was safe. Making a judgement from the comments given freely in question 18 and at the end of the questionnaire; it could well be the case that the 10% that were not sure could be convinced that using recycled grey water was in fact safe. Many of the people who are unsure about the safety of grey water could be reassured by further information. This would potentially take the total number of people willing to use recycled water to in excess of 90% of the

sample. This scenario is made all the more likely because of the fact 96% said they are prepared to invest in grey water systems.

Regarding what functions people find grey water acceptable for, it is clear that people are comfortable with the idea of using grey water for toilet flushing, irrigating flowers and car washing. These are all activities with limited human contact and the positive response is weaker for more intimate uses. Irrigating vegetables still scores just over two equating to a comfortable rating, whilst the average score for washing clothes is 2.6. With a value of three representing an uncomfortable attitude, many respondents were uncomfortable with the idea of using recycled grey water to wash clothes.

The open question in the survey gave respondents the opportunity to freely express their objections or concerns regarding grey water use. From this it is possible to explore why people are uncomfortable using treated grey water for washing clothes. From the comments given by the respondents the impression given is that people's main concern is that their clothes will not be cleaned properly or ruined. People do not like the idea of having clothes damaged or wearing something that is not clean.

Out of total 437 respondents eight people objected to the use of recycled water and 41 stated they were not sure. There were 53 people who made a comment for question 18, meaning most if not all those people gave their reasons for their stance. Those 53 comments were coded and grouped together to be quantified with similar comments. The most common comment was that people would like more information before committing to the use of recycled grey water. Other reoccurring reasons for objecting to the use of grey water are a lack of trust in the authorities who would implement the systems. This is not a new objection and evidence of opposition for this reason can be found in the literature.

People have also expressed their concern about using grey water to irrigate vegetables, because they thought it could contaminate their vegetables making them unsuitable to eat. Concerns about the impact on grey water use on health was the major objection, the cost of the system was mentioned by just one respondent to be excessive (however at that point in the questionnaire the price of the system had not been introduced).

Grey water recycling has widespread support from the customers, and the level of support could be increased if people could access more information on the subject. Broadly water customers are comfortable with the idea of using recycled water for a range of household applications. There are reservations about using grey water for washing clothes and irrigating vegetables, but these uses can be optional to the householder. The concern about using recycled grey water more personal applications is well documented in the literature, so these findings are as expected. It is unlikely

washing clothes would be a primary use for grey water, only being introduced at the homeowner's request or if the water conservation need became very great. The concerns respondents had were health related and worry about damage to clothes, but again a large proportion of people simply stating they would need more information to make a final decision. So of those people who commented on grey water recycling proportionally very few were outright rejections of the idea. The level of acceptance is slightly higher than what was found in the 2003 survey by Jeffrey. People either like the concept or would just need further reassurances before giving their consent.

5.4 Limitations

There are problems to note with the data. The way to answer some of the questions was misunderstood by a proportion of the sample. A number of the questions asked the respondents to rank the options to questions, in an order that matched their own opinions. Giving each option a different value, from 1 – 4 if there were four options for example. But some respondents gave an individual ranking for each option, meaning that two or more options were given the same value. Other problems with the ranking questions were that people ticked the boxes where they should have entered a number. The questions affected by these problems are 1, 2 and 14. For these questions there were 67, 37 and 95 incorrect answers respectively. The extent to which question 14 was incorrectly answered can be understood. Its position in the questionnaire came after a number of the questions that asked respondents to use tick boxes. This change in format could have caused confusion. Any questions that were incomplete or incorrectly answered were not entered into the database. Graphs drawn for question 14 from the database are therefore accurate representations of the correctly answered question. Over 430 responses were received and approximately 300 of those answered question 14 correctly. The original expected number of responses for this study was 200; so 300 correct responses for this question means reliable conclusions can still be drawn.

6 CONCLUSIONS

The environmental consciousness of the public has been growing in recent years. More people are making a concerted effort to make small changes to their lifestyle to help the environment, for example purchasing hybrid cars and buying local produce. Actions can be seen in day to day life, from the rise of recycling, to the demise of the plastic bag. The results of this survey have shown that the respondents are concerned

about water issues. Experience of the weather fluctuations in previous years has made them concerned about extremes of weather. However the concern is greater for droughts and water scarcity than for flooding, suggesting a strong basis for grey water acceptance.

External water use is an important feature of many people's lives, with gardening being the most important outdoor use. The cross comparisons made between how important the customers feel outdoor uses are to them and their willingness to pay did not show what was expected. There appeared to be no link between these two factors. But there was a potential problem with the presentation of Question 20, in that the 'every year' option was first in the list of answer alternatives. It was not possible to test the direction of this relationship another way. However respondents agreed strongly that having a reliable supply of water during a drought would encourage them to adopt grey water use. In addition to this the customers stated that they would invest in water saving technologies (dual flush toilet, water efficient appliances) rather than cut their water use in the garden. So the possibility that there is a relationship between importance of external water use and willingness to invest is still a reality. The existence of this link could be the subject of a further study. Cambridge Water's area of supply has not really experienced serious problems of supply in the past; so it may be interesting to focus on an area that has had a high number of hose pipe bans in the past for example.

The results have shown that many people are already taking steps to save water; and the data suggests that the majority of respondents would accept the non-potable use of grey water. There are reservations about using grey water for washing clothes and irrigating vegetables; of those people whom commented on grey water recycling proportionally very few were outright rejections of the idea. Cambridge Water can be confident in promoting grey water recycling; its customers are concerned about water issues and prepared to act. Many more customers could be convinced to adopt grey water recycling if they were given more information and had their fears addressed. This research has shown that there is sufficient support from customers to make grey water reuse a viable way to help ensure the sustainable management of water resources. Whilst the financial barrier may remain until the technology becomes cheaper or water scarcity more frequent, the concept of reusing grey water for non-potable application has widespread support.

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8 APPENDICES

8.1 Appendix A – Survey Questionnaire

8.1.1 Questionnaire

Dear Customer

Did you know the average person in the UK uses 150 litres of water every day? This is the same as one full bath and six flushes of the toilet. It is thought climate change will make Cambridgeshire drier, whilst at the same time the population of the region is set to grow. Cambridge Water recognises it is important to conserve water supplies for our use now and for generations to come by protecting our existing water resource, ensuring our leakage figures are as low as possible and engaging with our customers to raise awareness of water efficiency. This survey aims to explore your attitudes towards water, your consumption patterns and your thoughts about potentially using recycled water.



It will take approximately 20 minutes to complete. The majority of the questions simply require you to mark (X) next to your answer. Should you wish to provide any further comments, please use the available space at the end of the questionnaire. Your answers are completely confidential and will be released only as summaries in which individuals' answers cannot be identified. As your participation is voluntary, you are free to refrain from answering any questions you feel you do not wish to answer.

Before you complete this questionnaire, please read and confirm the following statement:

I have read and understood the above information. I consent to take part in this study

Thank you for your co-operation

SECTION A: Water and climate

1 The following list describes water-related climate change impacts which Cambridgeshire might experience in the future. In your opinion, which will be the most pressing problems in the region? Please enter a number from 1 to 4 in the box next to each problem, depending on how pressing you think they are. The most pressing issue should be given a 1 and the least a 4.

- More floods
- Rising sea levels
- Increasing problems with water scarcity and droughts
- Changed ecosystems

2 Please indicate how much of a negative effect you think each of the following sectors has on the availability of water for domestic use in your region. Please rank the following sectors according to their relative consumption. The sector having the highest consumption should be given a 1 and the one with the lowest consumption a 4.

Domestic	<input type="checkbox"/>
Industry	<input type="checkbox"/>
Agriculture	<input type="checkbox"/>
Tourism	<input type="checkbox"/>

3 “Water quantity problems” can mean either too much water, causing problems such as floods, or too little water due to droughts or over-consumption. Please indicate the extent to which you agree or disagree with the following statements.

	<i>Strongly agree</i>	<i>Agree</i>	<i>Disagree</i>	<i>Strongly disagree</i>
I am concerned about there being an increase in droughts in my region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am concerned about there being an increase in flooding in my region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am not concerned about problems with water quantity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION B: Attitudes and actions

4 Please indicate how much you agree or disagree with the following statements. Please mark the relevant box for each statement.

	<i>Strongly agree</i>	<i>Agree</i>	<i>Disagree</i>	<i>Strongly disagree</i>
Individuals should take responsibility for their environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do not have time to conserve water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I really have not thought much about cutting down my use of water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5 There are different ways to use less water. In order to reduce the amount of water used, have you undertaken any of the following in the last two years? Please mark the ones that you have undertaken.

- Not left taps running, e.g. whilst brushing your teeth
- Taken showers instead of a bath
- Installed water saving devices, such as low flush toilets
- Purchased water saving appliances, e.g. a dishwasher
- Used a watering can instead of a hosepipe in the garden
- Have not done anything
- Other. Please specify _____

6 How important is having a pleasing garden to look at and enjoy?

- Very important Go to Question 7
- Important Go to Question 7
- Not important at all Go to Question 7
- I do not have a garden Go to Question 10

7 How often would you say you water your lawn and borders during the summer months? Please mark only one box.

- More than once a week
- Once a week
- Once a fortnight
- Once a month or less

8 How important is growing and eating your own vegetables to you?

- Very important Go to Question 9
- Important Go to Question 9
- Not important at all Go to Question 9
- I do not grow vegetables Go to Question 10

9 How often would you say you water your vegetables during the summer months? Please mark only one box.

- More than once a week
- Once a week
- Once a fortnight
- Once a month or less

10

How important is it to you to have a clean car?

- | | | |
|----------------------|--------------------------|-------------------|
| Very important | <input type="checkbox"/> | Go to Question 11 |
| Important | <input type="checkbox"/> | Go to Question 11 |
| Not important at all | <input type="checkbox"/> | Go to Question 11 |
| I do not have a car | <input type="checkbox"/> | Go to Question 12 |

11 How often do you wash your car on average? Please mark one box.

- | | |
|---------------------|--------------------------|
| Once a week | <input type="checkbox"/> |
| Once a fortnight | <input type="checkbox"/> |
| Once a month | <input type="checkbox"/> |
| Twice a year | <input type="checkbox"/> |
| Once a year or less | <input type="checkbox"/> |

12 How important is it to clean the exterior and outdoor areas of your home?

- | | |
|----------------------|--------------------------|
| Very important | <input type="checkbox"/> |
| Important | <input type="checkbox"/> |
| Not important at all | <input type="checkbox"/> |

13 On average how often do you wash your windows, patio etc? Please mark only one answer.

- | | |
|----------------------------|--------------------------|
| Once a week | <input type="checkbox"/> |
| Once a fortnight | <input type="checkbox"/> |
| Once a month | <input type="checkbox"/> |
| Twice a year | <input type="checkbox"/> |
| Once a year or less | <input type="checkbox"/> |
| I do not wash the exterior | <input type="checkbox"/> |

14 The average person currently uses 150 litres of drinking water per day. The government would like to see this reduced to 130 litres per person per day by 2030. If you had to choose from the options below, which of the following activities are you likely to adopt to help conserve water?

The activity you are most likely to do should be given a 1, and the one you are least likely to do a 5.

- | | |
|--|--------------------------|
| Reduce my shower time by half | <input type="checkbox"/> |
| Water the garden once a week at the most | <input type="checkbox"/> |
| Wash my car once a fortnight at the most | <input type="checkbox"/> |
| Install a dual flush toilet | <input type="checkbox"/> |
| Purchase water efficient appliances, e.g. a water efficient dishwasher | <input type="checkbox"/> |

15 When you considered buying your new home, how important was water efficiency in determining which house you bought? Please mark one box only.

- Great importance
- Moderate importance
- Little importance
- No importance at all

SECTION C: Grey water recycling

Grey water is wastewater from showers, baths, and wash basins. Grey water can be reused after it has been filtered to remove hair, skin and soap products from the water and chemically or biologically treated. The potential level of human contact with the water in its end use will determine what level of treatment is required. It can typically be used to wash cars, water gardens and flush toilets.

16 Would you be willing to use recycled water if it met UK and European quality standards?

- Yes Go to Question 17
- No Go to Question 18
- Don't know Go to Question 18

17 If water was to become scarcer in your region, how comfortable would you feel about using recycled grey water for the applications below? Please mark only one answer for each application and then go to question 19.

	<i>Very comfortable</i>	<i>Comfortable</i>	<i>Uncomfortable</i>	<i>Very uncomfortable</i>
Toilet flushing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Irrigating flowers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Irrigating vegetables	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Car washing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Washing clothes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18

If you object to the use of recycled water, please let us know in the box below.

19

What would encourage you to use grey water? Please mark the relevant box for each statement.

	<i>Strongly agree</i>	<i>Agree</i>	<i>Disagree</i>	<i>Strongly disagree</i>
The knowledge that I am helping conserve the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The possibility of saving money	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If it provided a reliable supply of water during times of drought	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20

It has been estimated that a grey water recycling system would add £5,000 to £6,000 onto the cost of a new property. Cambridge Water is currently prepared to contribute £1,000 to that cost. This would add 2.5% to 4% to the cost of new properties in this region (for flats the cost is significantly lower at 1%). If droughts became more common in the East of England leading to limited water availability, under which of the following conditions would you be prepared to buy a house equipped with a grey water recycling system? Please mark one answer only.

- If there was a drought every year
- If there was a drought every two years
- If there was a drought every four years
- If there was a drought every eight years or even less frequently
- I would not be prepared to buy a house equipped with a grey water recycling system

21

Would you welcome grey water recycling systems becoming compulsory for all new builds? Please tick one box.

- Yes
- Yes, but only in areas where there is a shortage of water
- No
- Not sure
- Other, please state _____

SECTION D: General information

D1. How old are you?

- Under 20
- 21 – 30
- 31 – 40
- 41 – 50
- 51 – 60
- 61 – 70
- Over 71

D2. What is your highest level of education?

- Secondary school
- College
- University
- Other _____

- D3. Where do you live?**
- Cambridge
 - Other town/suburb
 - Rural village or community

Thank you for taking the time to complete this questionnaire

Your assistance with this survey into public water use and likely acceptance levels for grey water is much appreciated. If you would like to provide any further comments about your water habits and future supply solutions, please do so in the space provided below.

Please return your completed questionnaire in the envelope provided to **Cambridge Water, 90 Fulbourn Road, Cambridge, CB1 9JN**



Your chance to win £250

John Lewis

Vouchers

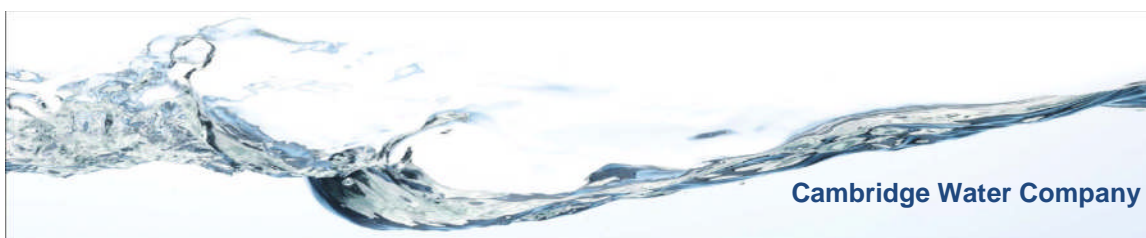
To enter the prize draw, please fill out your details below:

Name: _____

Address: _____

Tel: _____ Email: _____

These details will be removed from the questionnaire before the information is analysed and will in no way form part of the survey. The prize draw will take place on 24 August, with the winner being informed that day. There will be one prize winner, receiving £250 worth of John Lewis vouchers. Your details will not be used for any further purposes and will not be passed to any third parties.



8.1.2 Accompanying letter

Your chance to win £250 John Lewis vouchers

Dear (Salutation)

To assess the popularity of grey water systems, Cambridge Water has teamed up with Cranfield University to ask customers who have moved into a newly built home in the past two years to complete a questionnaire.

By gauging your opinion, we hope to understand how strongly water issues feature in the minds of new homebuyers.

As a Cambridge Water customer you live in one of the driest areas of the UK. We have less rainfall here than in Barcelona, yet we also live in one of the fastest growing areas, with our population predicted to increase by 50,000 over the next 25 years. It is therefore important that we conserve water supplies for our use now, and for generations to come.

One of the ways we can effectively conserve water is through incorporating grey water recycling systems into new homes when they are being built. Grey water is wastewater from showers, baths, and wash basins. If treated correctly it can be used for flushing the toilet, watering gardens and washing cars, helping to cut down water consumption by more than a third.

I am a postgraduate student at the Centre for Water Science at Cranfield University and am carrying out the survey with sponsorship from Cambridge Water. Your participation is voluntary. However, by taking a few minutes to share your experiences as a homeowner, you can make a valuable contribution to the future planning of the water supply and the construction of new homes. All responses will be treated confidentially. If you do choose to participate, and are happy to supply your contact details, your name will be entered into a prize draw for the chance to win £250 worth of John Lewis vouchers. Please complete and return the questionnaire **by 31 July 2009**. The research outcomes will be made publicly available by Cambridge Water in the autumn.

If you have any questions about the study, please contact either myself at Cranfield University d.m.horton@cranfield.ac.uk or Annalise Lister, communications manager at Cambridge Water on 01223 403176. Thank you very much for your co-operation.

Yours sincerely



David Horton

Cranfield University

8.2 Appendix B

8.2.1 Questionnaire comments

Question 5

Other

Water butt (13) (19) (21) (52) (80) (82) (97) (112) (132) (149) (150) (171) (174) (176) (134) (198) (227) (230) (231) (240) (275) (277) (300) (303) (326) (327) (363) (370) (381) (400) (407) (410) (413)

Considered a water butt. (47)

Have a Rain Harvest (1) (90) (125) (141) (208)

Use grey water when suitable (26) (61) (69) (76) (81) (106) (137) (130) (152) (179) (205) (233) (269) (284) (359)

Don't flush toilet every time. (40) (130) (177) (152)

Installed a water saving device in WC cisterns. (157) (181) (351)

Not having a dishwasher. (130) (132) (144) (243) (276) (351)

Only used dishwasher when have a full load (309)

Use dishwasher every other day (344)

Only use washing machine when I have a full load. (116) (130) (211) (309)

Use mini-load functions on washing machine (280)

Water efficient washing machine (344)

Hand wash (366)

Buy bottled drinking water. (12)

Fill kettle with minimum water. (12) (374)

Share bath with daughter (60)

Stopping water whilst soaping in shower. (68) (366)

We did not put the swimming pool for the kids in the garden this year. (69).

Only washing up when have sink full of dishes. (130) (313)

I have lived in a house with a water meter since 1990 and therefore have always been mindful of saving water although I prefer to bathe than shower and therefore only shower occasionally during hot spells. I will use a hose 1/2 times a week. (207)

Use washing up water for garden. (210)

I have used hand-washing water to wash hands after going to toilet. (305)

I have used the cold water which comes before the hot to flush the toilet with (this is not very successful) (305)

Installed water saving devices, such as low flush toilets

Already installed (5) (187) (8) (130) (289)

Purchased water saving appliances, e.g. a water efficient dishwasher

Don't have a dishwasher. (54)

N/A (57)

Don't use dishwasher even though I have one (222)

Used a watering can instead of a hosepipe in the garden

I use both (8)

N/A (57) (71)

Balcony only. (138)

In previous garden. (144)

Live in a flat (351)

Taken showers instead of a bath

We don't have a shower. (202)

I have a bowel problem and need to have a bath every morning. A shower is not enough. (305)

Question 7

More than once a week

Potato pots only (44) (403)

I use water from water butts in garden. (54)

Only at present as just laid new turf. (85)

Watering can only. (148) (198)

Depends on rainfall. (174)

Borders only (280) (302) (376)

Once a week

Borders (141) (210) (384)

Depends on rain (353)

Never water lawn (355)

Once a month or less

Water pots every day, don't water lawn. (187)

Lawn. (141)

Never (60) (90)

No lawns (95) (271)

Borders/ potted plants only (148) (172) (59) (8) (207)

Depends on the dryness... this very hot summer I am doing it once a week. But if it's not too dry I do not do it at all. (69)

Don't garden, are maintained and have not been watered in the 10 months I have lived here. (130)

I live in a rented flat. The garden is under a service agreement. (305)

Question 9

More than once a week

Again using water from water butts. (54)

I have an allotment. Water is supplied from an artesian well. (75)

From harvester. (125)

I have an allotment. (172)

None of the above. (8) (131)

Question 10

Necessary for work (295) (373)

Question 11

Once a month

But I don't wash it at home. (129)

Go to car wash. (27) (54) (261) (319) (363) (381)

Question 12

Not important at all

Only window to do and on 1st floor flat it's not easy to do. (130)

Important

With a broom rather than using water. (132)

Question 13

Once a month

Only with a cloth. (81)

I wash the bird poo off the patio paving slabs using a watering can and hard brush as often as I have time, e.g. every other day. (305)

Once a month/ Twice a year

Actually more like once every 2 months. (76)

I do not wash the exterior

I live in a flat (71)

We use a window cleaner: He comes on an ad hoc basis. (8)

Windows only (59)

Do not use water use a glass cleaner. (60)

N/A, living in a penthouse. (161)

Question 14

Install a dual flush toilet

Already have one (25) (26) (54) (69) (76) (80) (82) (122) (134) (130) (137) (143) (144)
(201) (203) (220) (280) (289) (302) (303) (305) (323) (373) (376)

Wash my car once a fortnight at most

N/A. (54) (76) (137)

N/A, wash car once a year. (150)

Already in practice. (82) (373)

Use a waterless car wash shampoo (302)

No car (305)

Purchase water efficient appliances, e.g. a water efficient dishwasher

Won't ever have dishwasher. (54)

Purchase when in need of replacement. (69) (144)

Dependent on finances. (76)

Already have them. (80) (82) (134) (137) (373)

Don't have room for one. Didn't buy a washer/dryer as would use too much water (280)

Not necessary for me at all (305)

Water the garden once a week at the most

N/A (71) (76) (130)

Don't water my garden (302)

Reduce my shower time by half

Already do. (76)

We don't have a shower. (202)

I believe things have equal weight.

Don't see how I can cut back anymore than I do. (60)

Already do them all. (73) (74) (104) (132) (141) (253) (353)

None – the 'government' will be long gone by 2030 – so will I probably! (8)

N/A (36)

N/A, see 7 and 11. (55)

Not really applicable, as I live in rented accommodation, and don't have a garden. (182)

Question15

Moderate importance

But no option to choose the use of grey water etc. (73)

Live in affordable housing, lacked choice (326)

No importance at all

Did not get say as its shared ownership I could not afford to be picky. (130)

Renting. (35) (176) (190) (210) (216) (403)

N/A built by us. (49)

When I was buying a home I was not very committed to save water and planet. (69)

It was a positive that the property I bought was built with water efficiency in mind – e.g. dual flush toilets, but it didn't influence which house I bought. (172)

Question16

Don't know

May increase certain types of spore containing bacteria?? (138)

I don't know what the 'Quality standards' are. (8)

Most people I now only worry about their water consumption when they receive their bills. (137)

Question 17

Washing clothes

Comfortable, I have eczema. (75)

Depends on the water through. (8)

This [answers to question] is based on using our own grey water rather than other peoples. (207)

Question 18

More information needed to make a decision (35) (54) (8) (75) (76) (89) (106) (120) (196) (202) (301) (339)

Lack of information: levels of water borne bacteria? Smell? Chemical staining/contaminant left on surfaces? Cost of recycling? (249)

Before agreeing to these measures I would need to know more about the cleaning process: what is involved. How much it would cost. How it is cleaned and sent back to me. What chemicals are involved in the process. The efficiency of the cleaning system vs using fresh water. (255)

Because it is being promoted politically I would have less than 100% confidence in the arguments for its safety. I would like the science to be separate from government. (314)

Don't trust it is clean and safe (6) (12) (41) (96) (115) (138) (212) (236)

Because it doesn't sound appealing (224)

I never drink tap water, so the only water I use is for washing clothes and dishes and showers. Don't want recycled water for any of that. (387)

Would ruin clothes. (405)

Cost too great (418)

I do for water used in food growing process as it would risk pathogens entering the food chain. Also for washing clothes for risk of infection transfer. Great for toilet flushing etc. Would it not be a better idea to use rain water for toilet flushing from gutters etc. (71)

On vegetables: would not want chemicals used to treat water going on our vegetables. (179)

I don't object, but I suppose it is psychological when it comes to vegetables (things we eat) and washing clothes. (144)

With regard to growing veg, we try to grow organic and therefore try when possible to use water from water butt, but as a second choice would prefer clean tap water. I would also prefer to use "clean" water for washing. (207)

Not sure of all the chemicals used would be ok for veg to be able to grow. (229)

For vegetables and clothes washing it would depend on treatment of water. Vegetables would worry me as its going back into the food again. Clothing because of how treatment chemicals affect sensitive clothes. (253)

It doesn't matter how much you treat the water I wouldn't want to use the water people wash in to drink or use it for anything edible. Plus I don't like the idea of added chemicals being added. There are already too many added chemicals in drinking water. Although some other uses above would be fine, i.e. toilet, car washing, irrigating etc. (273)

For washing clothes – I use a low temp cycle in my washing machine and adding recycled water may generate issues with hygiene, smells, etc.. (278)

I would wash clothes with clean water (347)

For eating vegetables and washing clothes I would prefer clean water. (380)

Not objecting, just not sure. (17) (77) (184)

I do not object to recycled water but have been advised by my German architect that the maintenance of the present systems can be problematic; I opted to install a water harvesting system, and then use the harvested water to flush toilets and water the garden. (208)

Grey water from baths/ showers will normally contain traces of faecal matter and I would not be happy if this was used for irrigation purposes. In addition, I would be concerned re possibility of viruses being spread if grey water used for laundry purposes. (323)

I do not object at all but wonder whether the energy used to “clean” the water, in situ, actually adds to other problems. (344)

If it's only for my house I don't object (316)

If it's only my waster water I don't object at all, but if it belongs to the whole population then psychologically it's harder to deal with e.g. washing your clothes in it. (148)

If each household has it's own grey water treatment how will it be maintained and it's effectiveness measured? If one has dual supply plumbing systems in a property how can one be 100% sure that cross-connection/ cross contamination will not occur? There are many more measures that the majority of households can adopt to improve water use efficiency without reverting to the use of grey water. Waster water in most instances best dealt with at a professionally run sewerage treatment works. (157)

To help save, but would only do this if I had to. (250)

I'd be happy to use my own grey water but less happy to use water which has had ecologically 'friendly' products in which would presumably necessitate further chemical use to treat. (265)

The use of recycled water should be strongly encouraged. (172)

With the effects of climate change and over population we have no choice but to use recycled water. (198)

Do not object. (204)

I do not object at all. However, my concern would be how the grey water would be how the grey water would come into the house or garden and preventing my young son from thinking it was ok to drink. Perhaps a non staining or non harmful dye could be used to prevent a young child making a mistake. (290)

I believe it is used as an exclusively the water companies not to replace their old leaky infra structure and also t build new infra structure from where the water is to where it is needed – build new reservoirs. Some strategies using engineering, not pushing it onto the individuals by using green guilt! (369)

Question 19

Drought

Having worked in the developing world in real drought conditions I think this term is not appropriate. (71)

The knowledge that I am helping conserve the environment

If an explanation of Q18 can remove fears of contamination. (138)

If it provided a reliable supply of water during times of drought

And if it were the only way to do so. (157)

There should be no water stoppages – it is your job to provide it. (8)

I think it's a fantastic idea. We need to encourage people to use eco-friendly washing powder, toiletries etc. (130)

(Made own box) Right thing to do. (141)

Answers depend entirely on the economics of such a system if installed in an existing property. (142)

Question 20

I would not be prepared to buy a house equipped with a grey water recycling system

Currently – due to low income (265)

None of the above (see previous) (8)

No idea (31)

Housing is expensive enough without having to pay more. (54)

But, I do not need to have a drought in the area. I will do it to save our environment. (69)

The government and or water companies should work with developers to ensure ALL new properties have a grey water recycling system. (172)

I don't want to have to pay extra (220)

Ticked 2 – I'm not sure which is cheaper (366)

I think the use of grey water is a very good idea but think that the cost of housing in Cambridge is highly inflated above the average persons earning potential and would not be happy having an additional 4% on the price of a property. A compromise on the cost of installing these systems needs to be found. (381)

I use a water butt to water my garden and veg and u think it should be made compulsory for all houses to have them as it helps save water. I would be interested in having a grey water recycling system depending on the cost of installing it. (382)

Question 21

Other

Yes if no cost to purchase and installation (14) (381)

Yes, if cost was reduced (403)

Subject to good life-cycle analysis such that unanticipated effects are better understood and mitigated. (15) (26)

Rainwater harvest (208)

I am not at all sure that it would be cost effective from a house owners point of view. (225)

Yes, but only if grey water was used for "comfortable" activities, e.g. NOT clothes washing. (230)

Yes, but would need to make initial cost to purchase lower (280)

£5000-£6000 is a lot of money, I would only consider paying this for a new property if there are incentives from 1) water companies 2) developers 3) government, i.e. discount on council tax, reduce water bills, government not take stamp duty if one grey water system is installed. (330)

If properties remain affordable then yes, if not then no. (341)

Absolutely not (369)

Yes

No question about it. (69)

Yes, but only in area where there is a shortage of water

If people are willing to live in a home with grey water recycling system (366)

Not sure

What about reusing rain water. (71)

Depends on cost (303)

The onus should be on the water companies to make these systems financially attractive so that the demand is generated. (149)

The cost should not necessarily be asessed on to the buyer. The planet would benefit if we ALL lived more sustainably. (172)

Question D2

Other

PhD (22) (232) (246) (279) (340) (369) (390) (405)

Masters (47) (103) (197) (191) (176) (203) (281)

Post graduate qualification (338) (345) (419)

Chartered accountancy (52) (180)

Technical school (55)

Professional qualification. (107) (225)

Professional management diploma. (176)

PGCE (178) (301)

Nursing College (300)

Cheeky – and almost stopped me from sending this back. At least you haven't asked me the ethnic question. (140)

Went to high school in USA (353)

Question D3

And Cyprus (8)

Other town/suburb

Longstenton (69)

St Ives Cambridge (108)

Cambourne (176)

Has a flat in Cambridge and a house in Sowesham

General Comments

When building this property eco friendly solutions were a high priority. We therefore installed a ground source heat pump for heating the house and hot water saving electricity, we also installed a rain harvesting system which is used to flush all the toilets, washing machine, and outside tap for watering the garden and washing cars. If Cambridge water prepared to contribute to this cost we would be delighted. We were *not* advised of this scheme even though I have spoken to Cambridge Water on numerous occasions. (1)

If there had actually been any option to have a grey water system as part of our new-built home, we would surely have considered it. Having just bought a house, we are not likely to buy a new one just because that one may have such a system. Having said that, our house does not even offer the opportunity to collect rain water for garden watering, which is quite a shame! (9)

I feel that business/industry/hotels etc. should be made to look at their consumption before individual households. (14)

I think that grey water recycling should not be compulsory especially as it will increase the cost of house prices. I would be happy to use grey water if it was affordable. I collect rainwater in a large water butt and find this invaluable for saving water to use in the garden and for washing cars. (19)

Solution = compulsory water butts in gardens which collect rainwater. (21)

Simple solutions like making water butt positioning work with drain pipes (during design), as using water from the bath to the garden is a pain in our new house. Baths and showers drained through a separate system to toilets. (26)

The issue of water use reflects our tragic understanding of what 'commons' hold in value within our society. Having sold and consulted into the construction industry over the past 30 years, I find it increasingly absurd that the decisions taken by those that

have the power to change things, (and the resources) value everything under the £ sign in the margin to ensure pension funds, bonuses, etc. and not to further our environmental conditions. (34)

I am from New Zealand where it is not uncommon to have summer water restrictions (generally applied to watering gardens and cleaning cars/ outside of house), why is this no an option in Cambridge? We have several levels: no restrictions, hand-help hoses only (no sprinklers/ soaker hoses), watering cans, and water ban during the hottest part of the day) i.e. when evaporation is at it's highest. Just a thought. (37)

Tenants cannot do many measures to save water – Cambridge has a huge population who rent accommodation privately – so it should introduce some measurements for landlords to implement water saving for their rented houses. (39)

I think collecting rain water is a better option for plants and gardens. However, the cost of setting up a water butt is so expensive vs. cost of water I chose not to! (47)

Suggestion – why not 'trap' rain water better by use of water storage, especially rain water overflowing from roofing during rain storms. Generally we need to trap' rain water more efficiently. (55)

When washing dinner plates etc cold water comes out first we save this for watering our flowers. (59)

At the moment I feel I cut back with water as far as I can, I use my washing up water to water my 6 flower pots, me and my daughter share our bath water, and we only flush our toilet after doing a number 2. Am on a water meter and I feel that if every house hold had one of these then they would appreciate water more and no waster it or use hose pipes/ pressure washers and turn the tap off for brushing teeth. Etc. (60)

Behaviour change is critical in fighting climate change related issues. However, it is very hard for individuals to change their habits. That's why measures taken to change technologies such as introduction of grey water recycling systems) need to be accompanied with adequate educational information in order to change individuals behaviour over time. (64)

We believe this is a constructive and valuable questionnaire. We hope this study will be fruitful, people must understand habits can always be changed, and it is important that we preserve our resources and environments. Way to go! (68)

I would like to adapt my house with a "grey water" system at a reasonable price. I also believe that with the strong winds in the area lots of villages/ towns should have

windmills to provide energy to the houses. Everybody should watch the movie "Home" or similar. (69)

I have been very impressed with the adverts on TV for Fit 4 Life. I have taken a lot of notice of these. It's sad to say that we are a nation of TV addicts but I think it would be good to have some adverts like that showing people how easy it is to reduce water usage hence helping the environment and saving money. I think this would be better instead of leaflets/ post as it can be easy to disregard these. Also people are lazy/ busy and sometimes don't find/ have time to read things. (72)

1. Water meters should be compulsory in all homes not only new build but existing. 2. Use of hose pipes for watering gardens, washing cars should be banned. 3. People must be encouraged to understand water is a precious resource and should be used wisely. 4. Commercial car washes should be heavily taxed/ have high rates for water. (74)

I am a strong supporter of the use of grey water systems. In the case of new build houses I feel that recycling systems should be installed compulsorily and as speedily as possible. (75)

We do our utmost to conserve but I strongly feel free water butts should be provided for every household who make an effort and it would use so much of the wasted water. I have lived in two countries where water was rationed and I consider water to be very important, never to be wasted. (81)

I was surprised how much extra money a grey water system adds to a new build. Barratt claimed lots of environmentally friendly initiatives in the building of my flat (Aug 2007) but I can't remember them mentioning water recycling. I would welcome a water butt to collect rainwater to use for garden/car I would welcome a low flush toilet. (101)

Section B, 4, in terms of conserving the water, the issue is about having enough space and investing the money into buying equipment necessary. You can always find time if you really want to. (111)

I take great care not to waste water when running hot tap, always put cold water in container for garden. Never fill washing up bowl. (115)

I feel that there should be somewhere one could go for advice on all the different systems to install in new builds. (125)

My house benefits from the solar panels and they are great when the sun is out, but taking into account we only have about 30 days of sunshine I would rather have a rainwater collector installed to use for flushing toilets and water the garden. (129)

I already have a dual flush toilet, no dishwasher, quick showers – use water butts to wash car and water garden. I would appreciate further advice. (132)

I do water my garden borders, but only use water that I have washed vegetables in, I have a new build, but we are not encouraged to save water – there is a communal car washing area, and points around the ground where you can attach hosepipes to water lawns etc. My neighbours cannot understand when I object to this. I would like to see all new builds with gardens provided with water butts to collect rainwater from the gutters as a matter of course. Even this small measure might help. I think a lot more education will be required before people accepts the more sophisticated grey water recycling systems such as those mentioned in questions.

The harvester system installed in my new build property is an interesting halfway measure. The collected rain water flushes the toilet and supplies the washing machine, the outside tap and therefore water for garden, car etc. It requires very little intervention, and no chemicals. (141)

I already live in a property with a water recycling system installed.. I believe that all households should be metered. Have all water companies achieved the economic level of leakage for their water supply networks? (144)

If I was planning to build a new house for myself, I would arrange to feed all roof rain water into an underground tank and use this source for toilets etc. Too much rain is currently being fed into combined drains. (149)

Some of your questions do not apply to us since we live in an apartment with a terrace on which we have flowers and shrubs in pots, rather than in a house with a garden. (151)

I have an allotment and small garden I RECYCLE VIRTUALLY ALL shower and bath water to water both my garden and allotment partly to save money and partly to help conserve water. I enjoy doing this despite the extra work and find it very satisfying. I also have a water butt and collect rainwater. (152)

I live in a flat so garden questions not relevant. (156)

I am not convinced that domestic grey water systems would achieve what is claimed for them in a trouble-free effective and sustainable way. Nor am I convinced that the

public health risk would be no greater than that achieved by present arrangements. (157)

The focus in the first instance should be on large-scale users of water, especially industry and agriculture, as this is where wastage and savings would be most effective. (162)

Water authorities could do a lot more to raise awareness of sustainability issues and encourage domestic water users to reduce water consumption. Also to think about the indirect ways they (domestic users) can save water, e.g. by being a more greener consumer in general. (172)

I would be interested in a large underground storage tank for water collection from downpipes, the cost at present is a deterrent, but it would be useful for outside water uses. (174)

Use water butt for garden. (181)

With the labour government targeting the region to meet it's quota for new housing, the conservation of water is a major issue. Quality of water will have to be compromised to meet the new demand. Larger rainwater tanks to capture rainwater would lessen reliance on mains water. My garden rainwater tank dries up in July/August/ September without fail. Grey water is the obvious solution. (198)

Is the grey water from one house hold only, we only re-use our own water? I'm not sure it is clear – or is it a few houses sharing 'treated' water? (202)

Have just moved into a new build flat this year and was rather surprised that they have baths and no showers. They are not suitable for the elderly or disabled so why design them like that? (205)

The targets for water consumption (domestic) in terms of litres per person per day are stricter at a regional level due to the East of England being the driest UK region (see regional economic strategy and East of England plan and East of England implementation plan which was preferred programmes for reducing domestic water consumption). See www.eeda.org.uk and www.eastofengland.com.uk (206)

I presume the grey water system would be used to recycle grey water within each individual household and feel most people would be happy with this. I also feel that all houses should have water butts off their downpipes or even underground storage for external use. (207)

Grey water systems are tempting but maintenance of filter systems and pump is, for the non technical or just plain lazy, a potential problem. Also grey water needs to be

regularly flushed through the system and any prolonged periods of non use can lead to build up of microbial growth. Summer holidays could be ruined by returning to find problems with the system and at worst potential health risks. (208)

The environment, and water conservation, is all our responsibility. People's behaviour is most likely to change only when guided by government policy at a local level. "We must use our grey cells to look after the green cells" (Jonathan Poiritt). (227)

Rain water collection will help as well. Teaching in schools too! (229)

We have recently moved to the area and are new to metered water but already have a water butt and bought water efficient appliances. Subsidised butts, pumps, irrigation systems or council advice on plants for dry gardens circulated to all houses. As we are new to metered water bills we are cautious in this first year and economising. (230)

Details of how grey water systems work would be useful. Simplicity and ease of use with minimal maintenance would make a big difference to using grey water systems and take up. (231)

Subsidised schemes to promote collection of rainwater for watering of garden and vegetables such as provided to households to promote composting. (241)

I would consider using grey water/ having a system fitted, if, in times of drought, I was given a priority water supply over those with 'regular' systems. (249)

You should include measures for the use of grey water in the building trade. I was amazed at how much water was required in the build. (254)

Having lived in Australia for 2 years, measures to save water have become common places. I think the UK needs to make people much more aware of the need to conserve water in the same way we have recently had campaigns on saving electricity- so that it becomes habit. (255)

I live in a new build flat in Chesterton and am surprised "grey water" systems are not already in place. However it is very energy efficient albeit doesn't have a shower. Maybe all new build properties should only have showers in a bid to make baths obsolete. I have also only purchased eco-friendly appliances. (260)

New house need to fix a equipment for recycle water. (262)

Collect and store rain water from the roof, instead of paying for it to be collected by Anglia Water, which would also play a role in preventing floods. (267)

Hopefully the council will pay part or all cost to upgrade existing properties. (278)

I think you have to be careful about selection bits in your survey, because people who are more environmentally conscious are more likely to find the time to fill out the survey. Regarding Q21, I oppose compulsion, but the cost of water could be priced in such a way as to make grey water systems economically compelling to home buyers. (283)

CWC needs to be seen to be enforcing it's rights at law with builders and assurers. (285)

The management of the natural elements of water and air needs to be undertaken by global body. In time such a strategy will become compulsory. (286)

There is no bath fitted in my flat. I do not have a garden or patio. I do not have a car. I do not have a dishwasher. (287)

When cleaning windows we do not use water, we only have a few tubs that we water, not borders or lawn and the cars are washed very infrequently to save our water. I find the main source of wastage in our house is when waiting for hot water to come through, we often run the "wasted" water into a watering can to water indoor plants. Thank you for the opportunity to participate in this important research. Good luck with it. (290)

Take showers every day. Chauffeur – must keep my car clean all the time. Summer, wash car 1-2 times a week. Winter, wash car 4-5 times a week. Quality of water not really relevant, as long as it takes the dirt off. (292)

People can save water by not using water to wash their cars and purchase waterless car shampoo (302)

I think more needs to be done by the water authorities to look after pipes and also in harnessing water when we get it. (303)

Why is there not a national water grid? The west and north of UK get a lot of rainfall. Also I am keen to see the number of leaks in the water supply system reduced. (306)

Please make supply of recycled water possible. (313)

An easy way to convert existing systems would be good. (318)

Water re-use is one area which is not covered in European Water Legislation. E C countries e.g. Spain and Greece recycle water for irrigation etc. but there is bacterial infections on crops. (323)

I'd like to know more about any local government or water company incentive schemes for use of water saving devices. Given the current finances climate, I can't see people voluntarily changing to or investing in more expensive water saving schemes unless you could prove long-term financial benefits. (327)

I think the use of water butts in the garden is a good idea for recycling rain water. At the moment I cannot afford to buy one or have it fitted onto my guttering. However I notice that all social housing in Cambourne which has recently been built has them in place. (329)

I would be prepared to use less water, but incentives/ penalties should be applicable to every household not just those in new builds. (339)

We contribute towards 'water aid' and are very aware of the true value of water worldwide and how easy it is to take it for granted. However with the current economic situation in this country and the difficulty, for first time buyers, to acquire a new home we wonder whether the extra cost of installing the grey water system would further inhibit house sales (and the impact of this spreads into so many other areas). What contribution would a future government be prepared to make as part of their own policies for tackling climate change? (344)

I think that there should be a lot more educational material into "grey water". The advantages should be pitched by independent parties, e.g. academics rather than commercial parties. It is also important not to make any one sector of society bear the cost more than other. E.g. new buyers (first time buyers) are probably those less likely to be able to afford an additional 4% cost on their new home. (345)

I am now living in a small block of apartments and would hate to be using water from the other people who are all years younger than me. When I lived in my own house I used a water butt for the garden and saved water from washing the vegetables etc also. I own this flat but am not responsible for the garden, I do not own a car now. (349)

I have seen a scheme in Australia where you can have a digital meter fitted inside your property that tells you exactly how much energy and water you are using and can give you a rough indication of cost, if you make people think money 'think' you can change the way people use water, maybe this could be something that could be fitted in "new builds". (351)

I think that it should be advertised more about grey water recycling because no one really knows about it. (366)

We have had clean potable water in the UK for over 100 years. It is a retrograde step to lower the quality in any form. We need a new Bazilgette to build new infra structure not to guilt trip customers – solutions to drought and shortages have to be social not individual. (369)

Thank you for the questionnaire. It has made me realise just how much I already do to help conserve water. I definitely agree with the grey water scheme although I would be apprehensive about using it on vegetables, but only because it sounds “dirty” when it isn’t. (373)

Grey water should be installed for flushing toilets in new builds. Installing dual flushing systems should be made compulsory for new builds. Grey water system could also be installed for garden sprinkling system in new builds. For educational purposes, people should be shown how the treatment works to clean grey water, i.e. the process to go through so that they don’t worry that the water is dirty. Potentially change the name to avoid the concern that “grey” is not clean. (374)

Having just moved into a new build, there was no outside tap, so can’t wash a car twice a year or water the 4 plants I have, have to use a bucket. The toilets installed are not dual flush either. More should be done in large industries where water is wasted more. (375)

I think all new houses should now be being built with the grey water system and not 10-20 years down the line. I have been in my new build house almost six months and would have been willing to pay the extra for the above system available. (384)

Disappointed at being told my supply could not be monitored. More investment in renewal of systems. (397)

I believe it is everyone’s responsibility to conserve water for future generations and solutions to make water always available however much that will cost the state or/and individual. (407)

More information is needed about how you can save water (410)

A rainwater harvesting system would have cost me £10000. all water from roofs would have to be electrically pumped either back into the house or into a stream (dense clay therefore no soak away possible). All gutters would need to be cleaned regularly and being 3 storeys could involve scaffolding. (418)

Observations

Questionnaires with some pages printed badly (51) (75) (94) (129) (129)

Q's from 3 through to 12 not been answered- think pages must have stuck together as rest is answered. (124) (307)

Q1 and Q2 – not answered correctly, did not understand. (125)

8.3 Appendix C

8.3.1 Further results

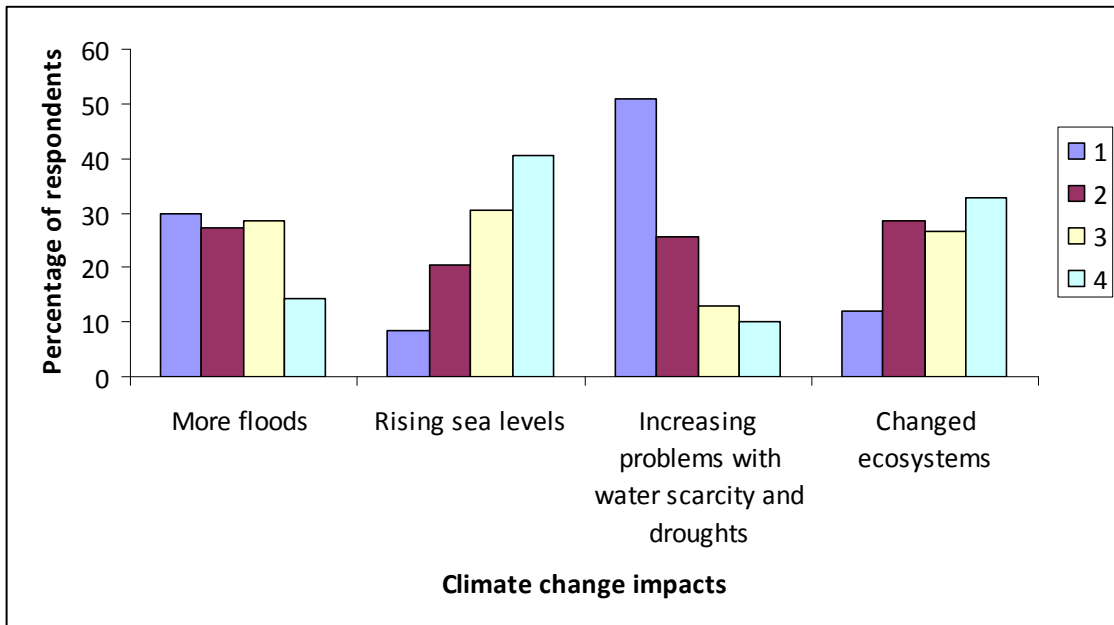


Figure 8.1: Respondents' ranking of the most pressing water-related issue in their region ('1' = most pressing, '2' = least pressing)

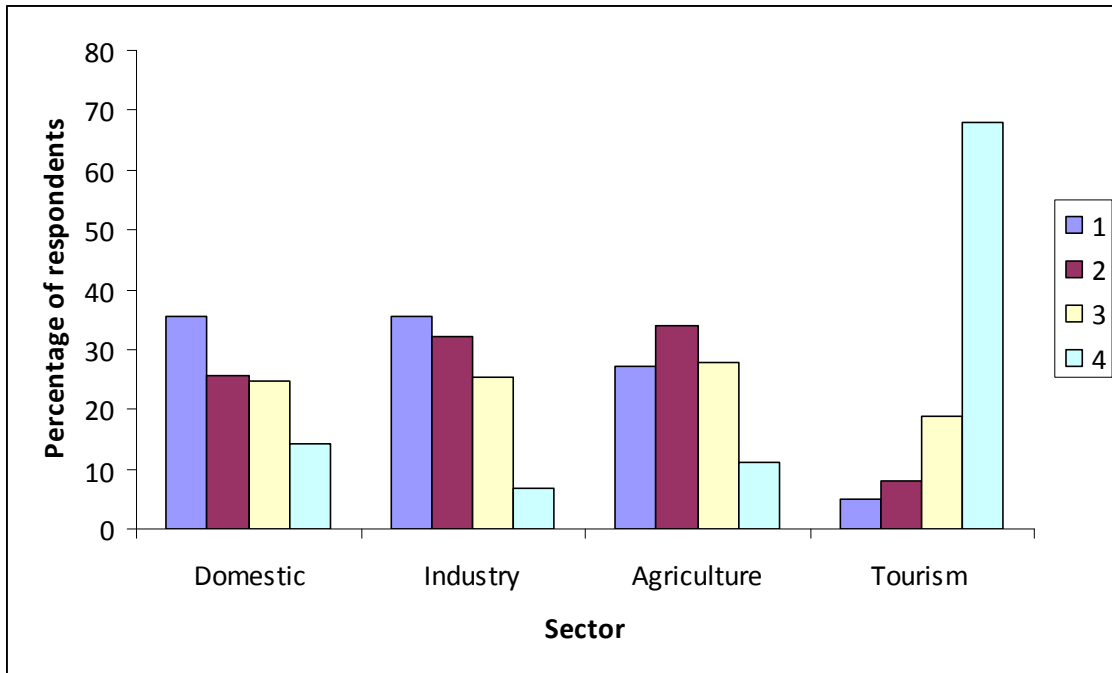


Figure 8.2: Respondents' ranking of sector according to its water consumption ('1' = most pressing, '2' = least pressing)

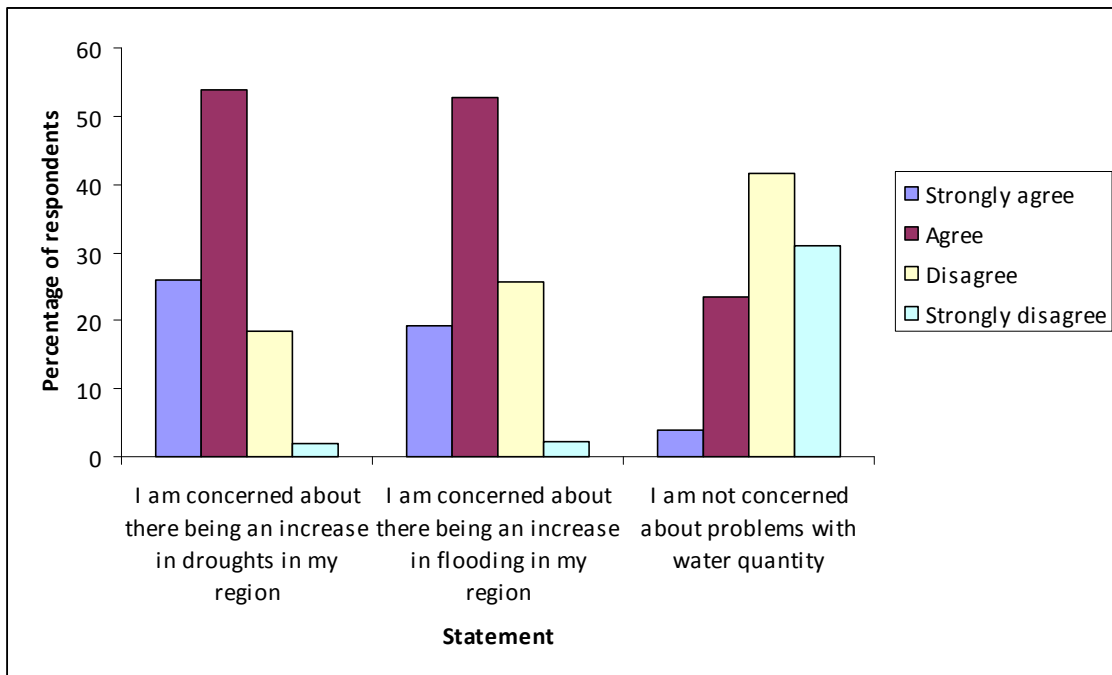


Figure 8.3: Respondents' reactions to statements regarding water quantity problems

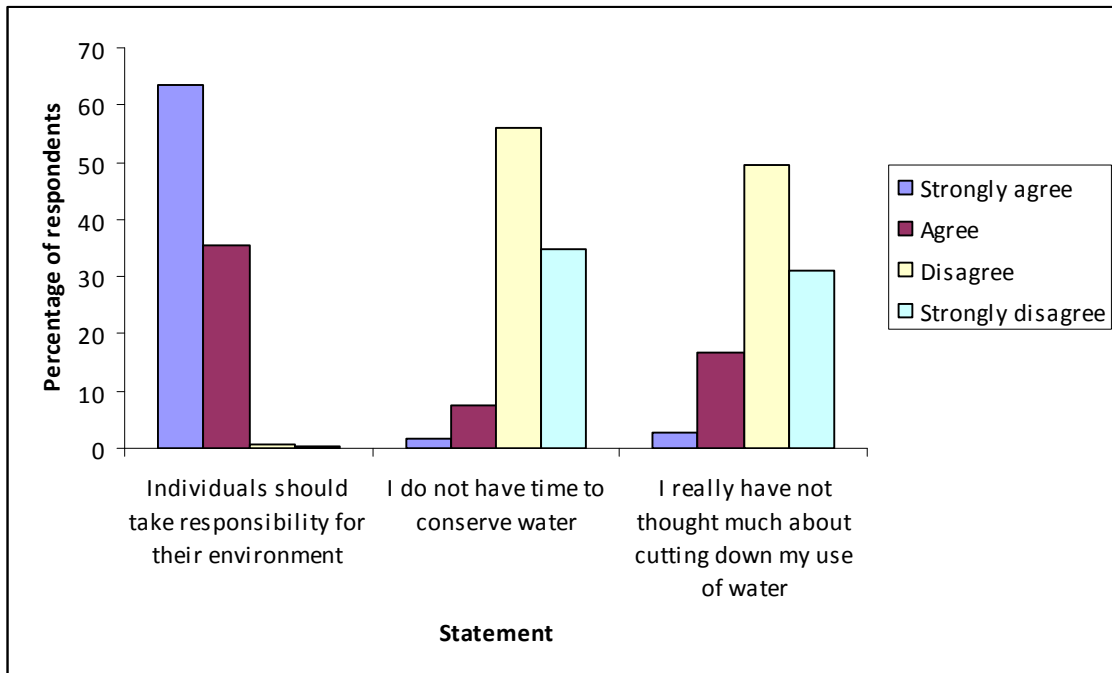


Figure 8.4: Respondents' attitudes towards water conservation

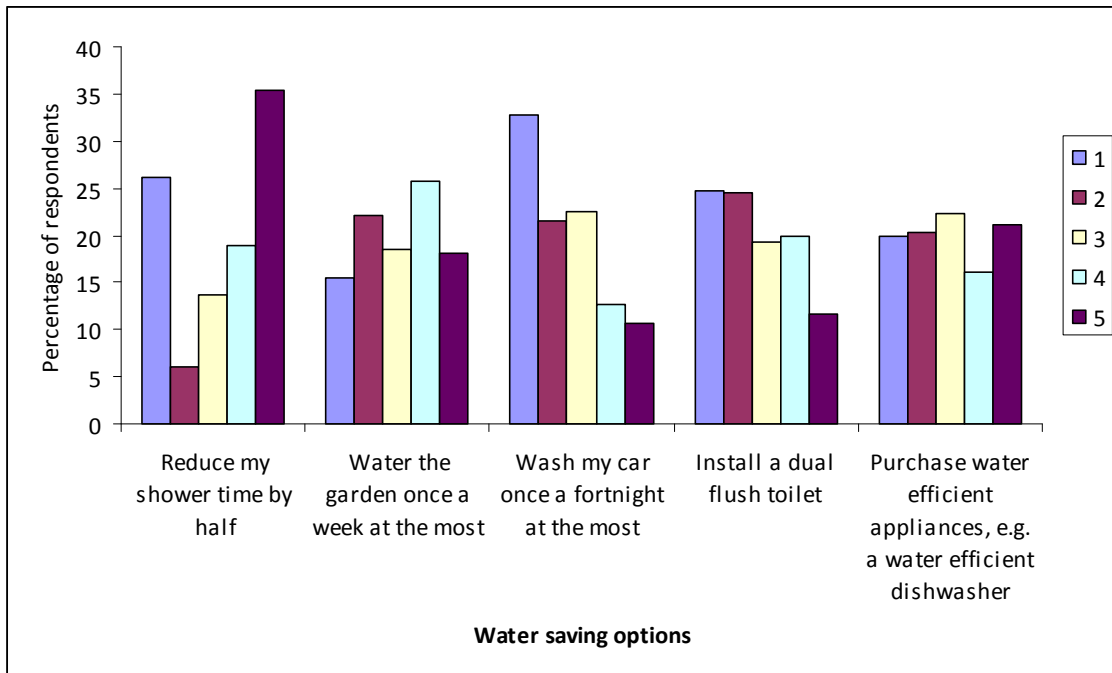


Figure 8.5: The likelihood of adoption of water saving techniques for the respondents ('1' = most likely, '5' = least likely)

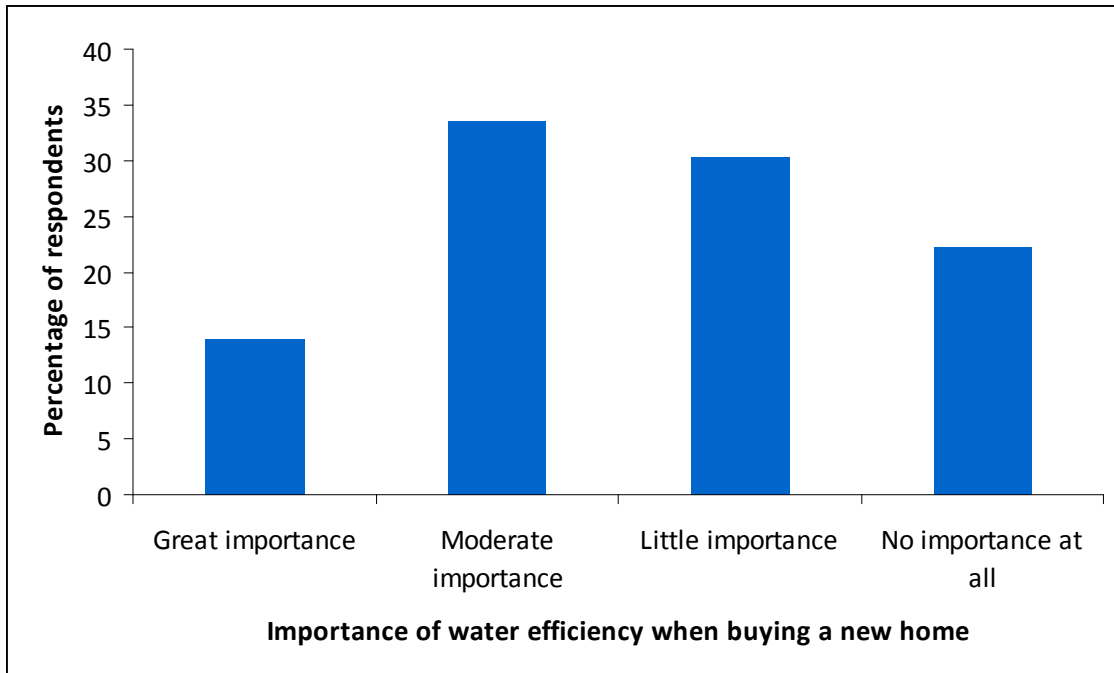


Figure 8.6: The importance of water efficiency in determining which house respondents bought

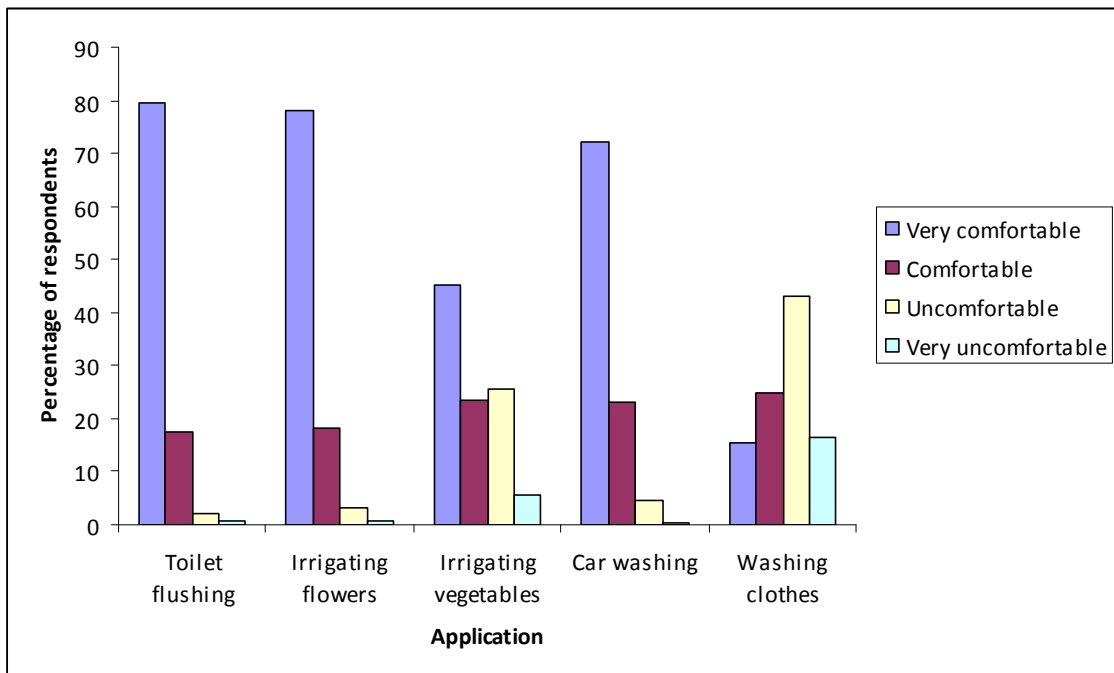


Figure 8.7: Extent to which respondents feel comfortable using grey water for different applications

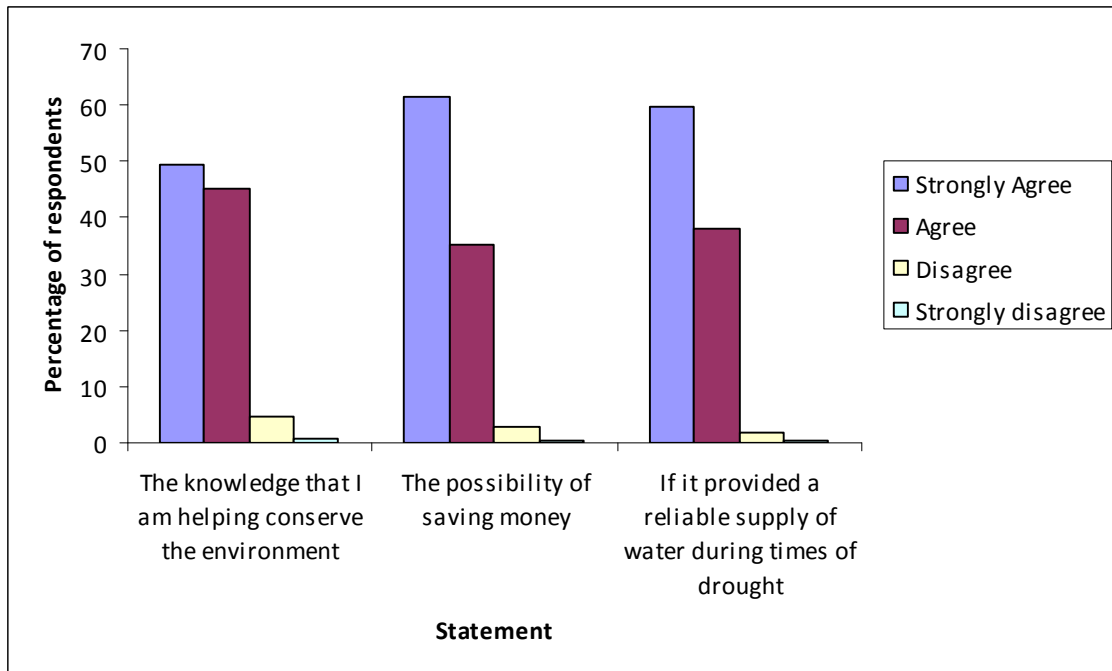


Figure 8.8: Reasons which would potentially motivate respondents to use grey water

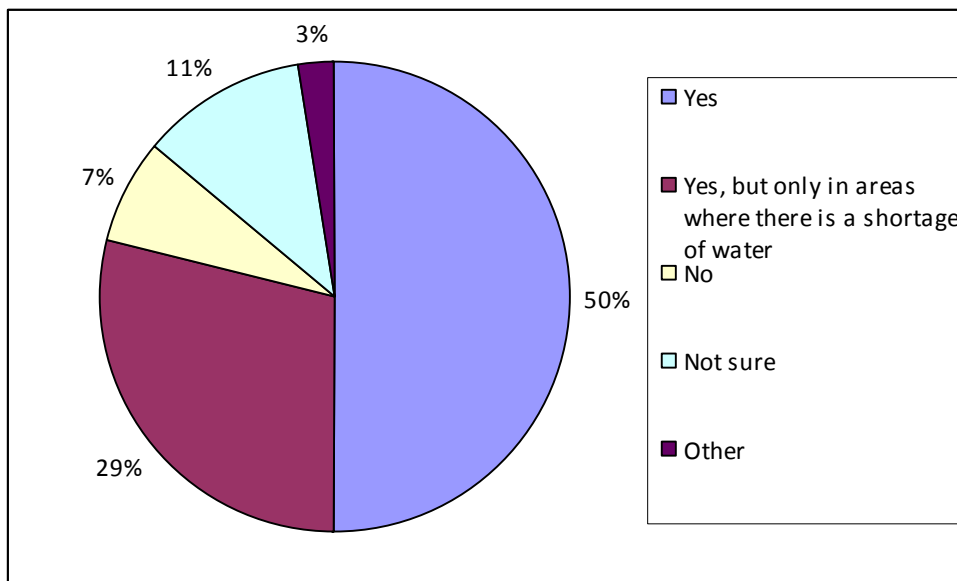


Figure 8.9: Extent to which respondents agreed that grey water should become compulsory in new builds

The answers to question 21 (should grey water recycling systems be compulsory in new builds) are shown below broken down by age group. The data suggests that younger people are more willing to see some level of government intervention to make grey water recycling systems a common feature in future homes.

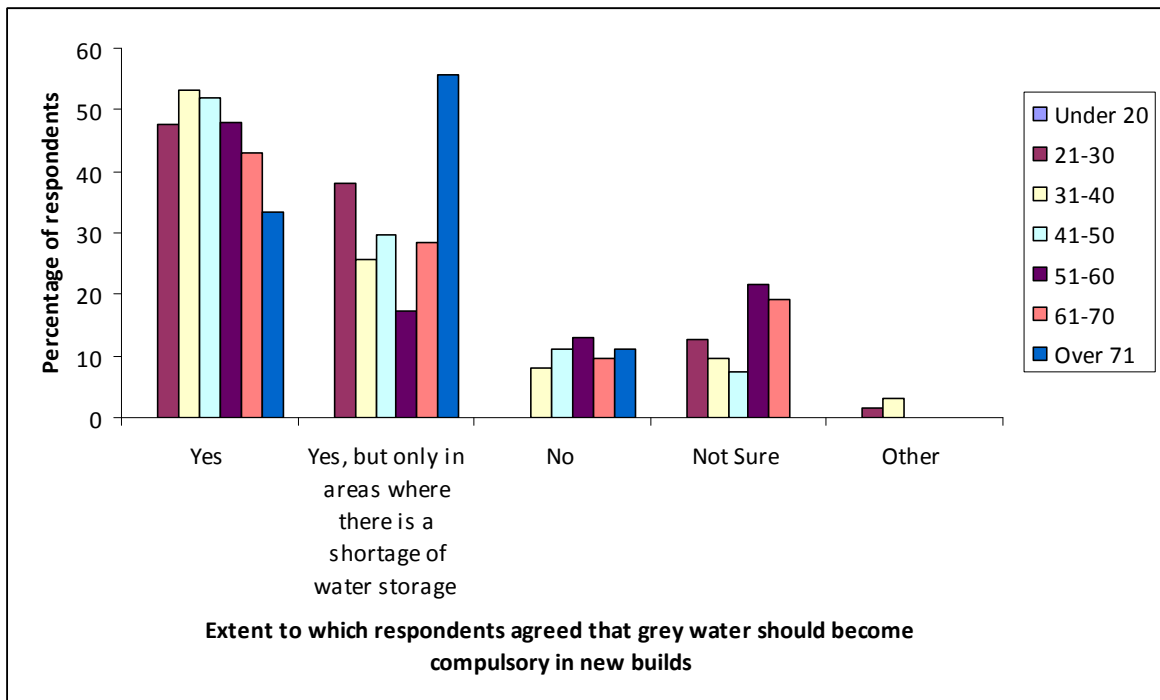


Figure 8.10: Extent to which respondents agreed that grey water should become compulsory in new builds

The respondents have shown that they would welcome the inclusion of a grey water requirement in future building codes. Just 2% of the sample is not willing to use recycled water, and 7% of people thought grey water recycling systems should not become compulsory in new builds. This indicates some people support the use of grey water but would not want to see its use enforced. However a large proportion of the respondents (79%) think grey water recycling systems should either be compulsory in all or selected new builds.

The respondents have shown that they would welcome the inclusion of a grey water requirement in future building codes. There must have been some respondents that indicated that they were willing to use recycled grey water but do not feel they should become compulsory in new builds. Just 2% of the sample is not willing to use recycled water, and 7% of people thought grey water recycling systems should not become compulsory in new builds. This indicates some people support the use of grey water but would not want to see its use enforced. However a large proportion of the respondents (79%) think grey water recycling systems should either be compulsory in all or selected new builds. This is a strong commitment from people towards grey water recycling; demonstrating that water customers would accept extra water efficiency requirements being placed on house builders, and the additional costs this could pass onto the home buyer. A comparison with the ages of the respondents also

suggested that younger people are more willing to see some level of government intervention to make grey water recycling systems a common feature in future homes.

8.4 Appendix D

8.4.1 Cross comparisons

Willingness to pay compared with importance of outdoor activity

	Ext. importance		
WTP	Very important	Important	Not important at all
Every 8+ yrs	15.81%	15.64%	16.84%
Every 4 yrs	4.46%	14.17%	19.50%
Every 2 yrs	30.59%	10.46%	19.07%
Every year	37.21%	52.94%	40.68%
Not prepared to invest	11.93%	6.79%	3.90%
Grand Total	100.00%	100.00%	100.00%

Table 8.1: Willingness to pay compared to importance of cleaning the exterior.

	Car importance			
WTP	Very important	Important	Not important at all	I do not have a car
Every 8+ yrs	21.79%	10.12%	18.25%	18.43%
Every 4 yrs	12.95%	14.88%	18.58%	9.10%
Every 2 yrs	29.82%	17.84%	23.68%	4.31%
Every year	26.51%	51.32%	35.03%	56.63%
Not prepared to invest	8.93%	5.84%	4.45%	11.53%
Grand Total	100.00%	100.00%	100.00%	100.00%

Table 8.2: Willingness to pay compared to importance of a clean car.

	Veg importance			
WTP	Very important	Important	Not important	I do not grow vegetables
Every 8+ yrs	20.67%	15.28%	15.84%	9.64%
Every 4 yrs	23.48%	21.92%	27.75%	8.40%
Every 2 yrs	22.44%	26.55%	23.84%	9.23%
Every year	29.38%	33.68%	32.57%	66.02%
Not prepared to invest	4.02%	2.56%	0.00%	6.71%
Grand Total	100.00%	100.00%	100.00%	100.00%

Table 8.3: Willingness to pay compared to importance of watering vegetables.

	Garden importance			
WTP	Very important	Important	Not important	I do not have a garden
Every 8+ yrs	10.78%	15.65%	14.24%	21.94%
Every 4 yrs	20.48%	14.79%	14.08%	11.19%
Every 2 yrs	30.25%	16.79%	23.14%	7.92%
Every year	35.46%	48.78%	43.61%	42.89%
Not prepared to invest	3.02%	4.00%	4.93%	16.06%
Grand Total	100.00%	100.00%	100.00%	100.00%

Table 8.4: Willingness to pay compared to garden importance.

Willingness to pay compared with frequency of external water use

	Freq. of ext. wash					
WTP	Once a week	Once a fortnight	Once a month	Twice a year	Once a year or less	Do not wash ext.
Drought every 8+yrs	0.00%	18.18%	12.71%	15.75%	19.12%	14.58%
Drought every 4yrs	0.00%	18.18%	19.49%	15.75%	19.12%	20.83%
Drought every 2yrs	0.00%	36.36%	27.97%	33.56%	25.00%	22.92%
Drought every year	100.00%	18.18%	38.98%	29.45%	32.35%	39.58%
Not prepared to pay	0.00%	9.09%	0.85%	5.48%	4.41%	2.08%
Grand Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 8.5: Willingness to pay compared to frequency of external washing.

	Garden watering frequency			
WTP	More than once a week	Once a week	Once a fortnight	Once a month or less
Drought every 8+yrs	10.62%	18.97%	8.82%	16.85%
Drought every 4yrs	18.58%	10.34%	26.47%	24.72%
Drought every 2yrs	33.63%	31.03%	32.35%	24.72%
Drought every year	37.17%	39.66%	32.35%	33.71%
Grand Total	100.00%	100.00%	100.00%	100.00%

Table 8.6: Willingness to pay compared to frequency of garden watering.

	Freq. of car wash				
WTP	Once a week	Once a fortnight	Once a month	Twice a year	Once a year or less
Drought every 8+yrs	13.33%	5.77%	16.15%	17.07%	15.79%
Drought every 4yrs	6.67%	11.54%	20.77%	19.51%	26.32%
Drought every 2yrs	20.00%	44.23%	24.62%	32.52%	31.58%
Drought every year	53.33%	34.62%	36.92%	27.64%	21.05%
Not prepared to invest	6.67%	3.85%	1.54%	3.25%	5.26%
Grand Total	100.00%	100.00%	100.00%	100.00%	100.00%

Table 8.7: Willingness to pay compared to frequency of car washing.

	Freq. of veg watering				
WTP	More than once a week	Once a week	Once a fortnight	Once a month or less	
Drought every 8+yrs	20.75%	11.11%	14.29%	7.69%	
Drought every 4yrs	20.75%	30.56%	28.57%	61.54%	
Drought every 2yrs	25.47%	27.78%	42.86%	23.08%	
Drought every year	33.02%	30.56%	14.29%	7.69%	
Grand Total	100.00%	100.00%	100.00%	100.00%	

Table 8.8: Willingness to pay compared to frequency of vegetable watering.

8.5 Appendix E

8.5.1 Question development

Table 1 Sample choice modelling set

	Option A (Current Practice)	Option B	Option C
Without warning your house might be without water from...	5:30 am to 11:30 am (i.e. 6 hours)	5:30 am to 9:30 am (i.e. 4 hours)	5:30 am to 7:30 am (i.e. 2 hours)
In the last year your water supply has never been interrupted. The water company tells you that your supply might fail...	Two more times in the next 12 months	One more time in the next 12 months	No more times in the next 12 months
You are advised about the interruption by...	A card put in your letterbox after the interruption	A phone call to let you know what was happening	A knock on the door to let you know what was happening
The alternative water supply arrangements offered were...	None unless you requested it	Water was provided at a central location (e.g. water tanker in the street)	A 2 litre bottle of water was delivered to every household where someone was home
As part of this package, your annual water bill will...	Stay the same	Increase by \$40	Increase by \$80

Figure 8.11: Existing question, inspiration for question 20.

Below there are three scenarios for future water supply, each one has its own costs and benefits, Given the following options, which would choose for your own home? Please tick box A, B or C.

	Option A (Current Practice)	Option B	Option C
There will be water use restrictions, e.g. hose pipe bans every...	Year during the driest periods	Three years on average	Never for homes recycling water
The quality of the water used in and around the home is...	All of drinking water standard	All of drinking water standard	Drinking water standard for human consumption and washing. Grey water for watering gardens, flushing toilets etc
As part of this package, your annual water bill will...	Stay the same	Double	Decrease but initial outlay of £5500 on top of the cost of a new house for the system.

Option A

Option B

Option C

Figure 8.12: Draft question 20

It has been estimated that a grey water recycling system would add £5,000 to £6,000 onto the cost of a new property. Cambridge Water is currently prepared to contribute £1,000 to that cost. This would add 2.5% to 4% to the cost of new properties in this region (for flats the cost is significantly lower at 1%). If droughts became more common in the East of England leading to limited water availability, under which of the following conditions would you be prepared to buy a house equipped with a grey water recycling system? Please mark one answer only.

- If there was a drought every year
- If there was a drought every two years
- If there was a drought every four years
- If there was a drought every eight years or even less frequently
- I would not be prepared to buy a house equipped with a grey water recycling system

Figure 8.13: Final question 20