The Role of Physical and Psychological Factors in Understanding Rainwater Tank Maintenance

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The Urban Water Security Research Alliance (UWSRA) is a $50 million partnership over five years between the Queensland Government, CSIRO's Water for a Healthy Country Flagship, Griffith University and The University of Queensland. The Alliance has been formed to address South East Queensland's emerging urban water issues with a focus on water security and recycling. The program will bring new research capacity to South East Queensland tailored to tackling existing and anticipated future issues to inform the implementation of the Water Strategy.

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FOREWORD

Water is fundamental to our quality of life, to economic growth and to the environment. With its booming economy and growing population, Australia's South East Queensland (SEQ) region faces increasing pressure on its water resources. These pressures are compounded by the impact of climate variability and accelerating climate change.

The Urban Water Security Research Alliance, through targeted, multidisciplinary research initiatives, has been formed to address the region's emerging urban water issues.

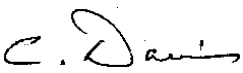
As the largest regionally focused urban water research program in Australia, the Alliance is focused on water security and recycling, but will align research where appropriate with other water research programs such as those of other SEQ water agencies, CSIRO's Water for a Healthy Country National Research Flagship, Water Quality Research Australia, eWater CRC and the Water Services Association of Australia (WSAA).

The Alliance is a partnership between the Queensland Government, CSIRO's Water for a Healthy Country National Research Flagship, The University of Queensland and Griffith University. It brings new research capacity to SEQ, tailored to tackling existing and anticipated future risks, assumptions and uncertainties facing water supply strategy. It is a $50 million partnership over five years.

Alliance research is examining fundamental issues necessary to deliver the region's water needs, including:

- ensuring the reliability and safety of recycled water systems.
- advising on infrastructure and technology for the recycling of wastewater and stormwater.
- building scientific knowledge into the management of health and safety risks in the water supply system.
- increasing community confidence in the future of water supply.

This report is part of a series summarising the output from the Urban Water Security Research Alliance. All reports and additional information about the Alliance can be found at http://www.urbanwateralliance.org.au/about.html.



Chris Davis
Chair, Urban Water Security Research Alliance

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EXECUTIVE SUMMARY

Under the Queensland Development Code (QDC) Mandatory Part (MP) 4.2, all detached Class 1 buildings constructed after 2007 are required to save 70 kilolitres (kL) of mains water per year. The most common method for achieving this savings target is through the use of household rainwater tanks.

Regular tank maintenance by homeowners is required to ensure that the mains water top-up systems are functioning properly; failure may cause significant usage of mains water. This study examines the role of physical and psychosocial factors in determining rainwater tank maintenance behaviours among owners of mandated tanks, i.e. "mandated tank owners". This report is part of wider research to investigate the various aspects surrounding the implementation of mandated rainwater tanks in South East Queensland (SEQ). Our findings provide an important preliminary guide for future research on governance and management models for decentralised water systems in SEQ and other urban areas.

A mailout survey (see Appendix) was used to recruit and gather information from 754 households from four Local Government Areas (LGAs) in SEQ. The four LGAs were Caboolture, Pine Rivers, Gold Coast and Sunshine Coast. The homes included were new dwellings built from 2007, and had internally plumbed rainwater tanks. It was hypothesised that the psychosocial factors of perceived competence, autonomy and ownership would be positively related to the regularity of tank maintenance. It was also hypothesised that past personal experience with having a rainwater tank would predict the respondent had a positive attitude towards regular tank maintenance as well as self-perceived competence in tank maintenance. General responses and personal information (demographic, psychological) were gathered from the mailout survey (e.g. attitudes to rainwater, acceptability of rainwater for domestic uses, perceptions of responsibility and willingness to pay for maintenance) were analysed using descriptive statistics, analyses of variance, and multiple regression analysis.

Analyses of the psychosocial factors showed that homeowners' perceptions of their own competence in maintaining their tank were found to be the most important predictor of regular tank maintenance behaviours (e.g. monthly, every three months, every six months, etc.). Results showed that perceived competence by mandated tank owners, alone, explained 24% of the variance in regularity of tank maintenance scores, indicating that perceived competence reported by mandated tank owners was a good predictor in determining their regularity of tank maintenance.

Autonomy, while found to be a significant factor, accounted for only 4% of the variance in tank maintenance behaviour. This suggests residents' beliefs that the government was advocating homeowner independence with respect to rainwater tank installation is a significant, but weak, predictor of maintenance behaviour. Further, the research indicates that feelings of personal choice are important to homeowners and can encourage more regular tank maintenance.

The psychological data in this study also indicated that perceptions of tank ownership were not important predictors of competence or self-reported tank maintenance. Analyses of results showed that most participants were happy to maintain their rainwater tanks themselves, or with assistance from the local council. An overwhelming majority of participants were not in favour of water utilities being responsible for tank maintenance.

Results from analyses of the physical tank set-up showed that 39% of participants either did not know or were not sure whether their rainwater tanks were connected to mains water for back-up supply. The data also indicated that 44% of participants were not aware of any trickle top-up or automatic switching device installed on their tanks (to allow mains water flows if the rainwater is not available), which is a compulsory feature of mandated tanks. The overall absence of knowledge among a high percentage of mandated tank owners indicates that these homeowners might not be maintaining their tanks to the required standard for the tank to be effectively saving mains water.

These findings suggest that to improve maintenance knowledge and behaviours among mandated tank owners, some key issues need to be addressed. Education campaigns to raise awareness of tank systems and improve maintenance behaviours will help mandated tank owners ensure a secure, long-term alternative water supply.

1. INTRODUCTION

The aim of this research was to understand how physical and psychosocial factors can explain the tank maintenance behaviours of households with mandated rainwater tanks. In South East Queensland (SEQ), all Class 1 homes built after 1 January 2007 are subject to water conservation measures. At the time of writing, the Queensland Development Code (QDC) Mandatory Part (MP) 4.2 stipulates that new homes must install water saving devices that allow detached household to save approximately 70 kilolitres (kL) of mains water per year. Semi attached homes, such as townhouses, are required to save 42 kL of mains water per year. One method for achieving this is through installing a 5 kL rainwater tank connected to 100 m^2 of roof catchment area and plumbed to various water fixtures for non-potable end-uses, such as toilet cisterns, washing machine cold water tap, and at least one external tap.

1.1. Understanding the Physical Setup of Mandated Rainwater Tanks in SEQ

It has been demonstrated in the literature that the use of rainwater from 5 kL tanks can significantly reduce households' mains water use throughout Australia (Gardner and Vieritz, 2010). As per the SEQ Water Strategy (2010), it is expected that alternative water resources (rainwater and stormwater) in new developments will reduce demand on bulk water supplies by nearly 7% by 2056.

There is little information on the proper maintenance of mandated rainwater tanks to ensure their long term operation and to predict potential failure rates as a result of poor maintenance. Since the installation of plumbed rainwater tanks in new Class 1 residential dwellings is currently mandatory in SEQ, it is important to understand social factors influencing the use of rainwater tanks, particularly factors related to their effective maintenance and, thus, their capability to securely supply rainwater as an alternative water source.

Previous research, conducted by Mankad *et al*. (2012) using the Computer Assisted Telephone Interview (CATI) approach, targeted 1,134 mandated rainwater tank users in SEQ. The study revealed a significant proportion of residents who either have: (1) low compliance to the basic criteria of QDC MP4.2; or (2) limited knowledge of the biophysical setup of their plumbed rainwater tanks. This research included assessing whether homeowners knew the size of their rainwater tank, the size of the roof catchment area connected to their rainwater tank, whether their rainwater tank was plumbed for various end uses, and about the existence and functionality of a trickle top-up system or automatic switching valve to ensure continuous water supply for the plumbed applications (i.e. with mains water back-up). It was argued that a poor understanding of the physical setup of rainwater tanks by the homeowners might result in a lower regularity of tank maintenance which, in turn, might have a significant impact on the rainwater supply reliability from rainwater tanks. Moglia *et al*. (2011) suggested that the maintenance of rainwater tanks requires the observance of simple and uncomplicated routine tasks, such as: regular cleaning and maintenance of gutters and first-flush devices; regular cleaning of strainers or filters to prevent blockage of the tank inlet; ensuring adequate protection of tank openings to prevent entry of vectors or breeding of mosquitoes; and upkeep of the tank's structural integrity and pump systems.

Two aims of this study are to examine homeowners' degree of understanding about the set-up of mandated rainwater tanks and to determine the regularity with which they are maintained (i.e. assess how often homeowners actively engage with their rainwater tanks). The basic information on homeowners' knowledge of rainwater tanks will be assessed in conjunction with the regularity of their tank maintenance, to highlight the contributory role of physical and psychosocial factors in understanding the maintenance issues with mandated rainwater tanks in SEQ.

1.2. Psychosocial Factors Important in Understanding Mandated Rainwater Tank Usage in SEQ

There is limited empirical research in the urban water literature examining water use attitudes and behaviours among homeowners with mandated rainwater tanks. This includes limited research not only on public acceptance of decentralised systems technology, such as rainwater tanks, but also on the understanding of day-to-day engagement with rainwater tanks at the household level. These important psychosocial variables are likely to be influential when understanding domestic rainwater consumption among communities in SEQ with mandated rainwater tanks, as social factors related to active engagement can greatly influence public uptake of novel technologies (Mankad and Tapsuwan, 2011). It is also important for water researchers, administrators and stakeholders to understand the implications of psychosocial factors on understanding the physical aspects of decentralised systems, such as rainwater tank system set-up and maintenance, because these relationships can provide better understanding of whether or not decentralised systems are being optimally utilised in urban environments.

Preliminary research by Mankad and colleagues (2010) alluded to the influence of psychological factors in the acceptance and use of decentralised systems. For example, they found that perceptions of water use *culture* in Australia play an important role in public attitudes toward urban water use and acceptance of decentralised systems. Their review also reported that perceptions of water or environmental knowledge appeared to play a key role in forming people's attitudes toward decentralised systems. Specifically, those with greater perceived knowledge tended to report greater acceptance of rainwater and greywater. Subsequent social research conducted within the Urban Water Security Research Alliance by Mankad *et al*. (2011) found that people with mandated rainwater tanks vary in their motivational orientations, when compared to SEQ residents with retrofitted rainwater tanks. People with mandated rainwater tanks had little directed motivation to engage with their rainwater tank, compared with householders with retrofitted tanks (Mankad *et al*., 2011). As a result, this amotivation displayed by mandated tank owners was found to be related to less regular tank maintenance and less adequacy in the adherence to recommended guidelines of maintenance. The authors concluded that, while effect sizes were small, there was a significant observable difference between the attitudes and behaviours of retrofitted and mandated rainwater tank owners, even though the impact of these differences was minimal. Mankad *et al*. (2011) encouraged future research to explore the self-determining influences of competence and autonomy (e.g. personal choice and independence), in particular, with respect to tank maintenance among mandated tank owners, as well as considering the role of perceptions of tank *ownership*, which Mankad and colleagues argued could relate to the concept of autonomy.

1.2.1. Conceptual Framework

The underlying theoretical framework being used in the present study is self-determination theory (SDT) (Deci and Ryan, 1991, 1995), which uses the role of psychological drivers in explaining motivation and subsequent directed behaviour. In its entirety, this theory describes the motivational influence of perceptions related to choice (e.g. why do people choose to maintain their tank) and the degree to which an individual's behaviour is self-determined (i.e. self-motivated). According to Deci and Ryan (2002) and Ryan and Deci (2000), there are three innate psychological needs that must be fulfilled in order to self-motivate individuals to engage in a particular behaviour:

Competence	Autonomy	Relatedness
Belief that one has the ability to deal with the situation they are experiencing	The desire to be a causal agent of one's own life, independence	The need to interact with others and be connected

In the present context, the focus is on how *competence* and *autonomy* influence rainwater tank maintenance. *Relatedness* is not a variable of interest in the present study as personal interactions with others is not the focus. Therefore, the concept of relatedness will not be presented further.

1.2.1.1 Competence

In the context of mandated rainwater tank users, perceptions of *competence* refer to an individual's belief in their ability to appropriately maintain their rainwater tank system. For example, knowing how and when to inspect and fix mosquito screens, check roofs and gutters and clean out debris. Perceptions of competence may also be influential when using rainwater around the home; this relates to how knowledgeable one may feel with respect to using rainwater (e.g. knowing that the rainwater is used for toilet flushing and understanding that rainwater is acceptable to be used in the washing machine).

In the present study, it is also argued that past experience and existing knowledge of alternative water may influence perceptions of competence. The relationship between personal history and competence has not been tested within the decentralised water literature as yet; however, there is some support for this hypothesis. Results from Mankad *et al*. (2010) and Gardiner *et al*. (2008) demonstrated that, while the majority of Australia's population resides in urban centres, there is a significant proportion of residents who are likely to have grown up on rural or peri-urban properties and, thus, have used rainwater tanks and/or other forms of decentralised water during their childhood or earlier adult life. This suggests that perhaps there are distinct differences in perceptions of competence between mandated users of decentralised systems, depending on an individual's past or existing lifestyle experiences. Therefore, personal history is an important variable to consider when examining psychosocial factors that may influence tank maintenance attitudes and behaviours.

1.2.1.2 Autonomy

The concept of *autonomy* in the present study refers to an individual's perception that they were free to make the decision to have a rainwater tank at home, independent of the government mandate. SEQ residents with mandated rainwater tanks are a unique population as they essentially had no choice but to have a rainwater tank. However, in some instances, homeowners may have wanted to install a rainwater tank at their home anyway, independent of what the building code guidelines may have dictated. Thus, the autonomy variable is the degree to which one may perceive that the decision to have a tank was made solely by the government or whether they perceive themselves as having had considerable input into the decision (e.g. in terms of design, quality). This perception of autonomy, either high or low, may influence the degree to which individuals feel motivated to engage with the rainwater tank and perceive it to be a desirable element of household infrastructure, such as choosing to learn more about the system and demonstrating motivation towards regularly maintaining it.

1.2.2. Past Environmental Research using Self-Determination Theory (SDT)

As discussed, Deci and Ryan (1991) posit that people's motivation to engage in behaviour is affected by their perceived competence and sense of agency (i.e. causation of one's volitional actions). Events that promote these feelings (e.g. government support of one's autonomy) are thought to increase self-directed motivation, while events that undermine these feelings (e.g. lack of success or feedback) are expected to decrease motivation. Past research using SDT to examine pro-environmental behaviours has found that in order to initiate environmentally conscious action, such as utilising rainwater tanks, people must have knowledge of the specific actions they need to engage in to influence environmental change (Arcury and Johnson, 1987; Pelletier, 2004). In the present context, this means that people must have a sense of what behaviours are important with respect to rainwater use and tank maintenance in order to feel competent enough to engage in the actions.

Pelletier (2004) further stated that, within the environmental domain, people are influenced by the social surroundings within which they must engage in particular behaviours. An important example of a social channel from which information is received is the overarching government context regarding environmental issues. The role of the government is particularly relevant when discussing urban water issues in Australia and, more specifically, in SEQ. In these areas, the subject of urban water has dominated public media and government rhetoric to the point where most people living in urban areas have been exposed to various and sometimes contradicting urban water messages (e.g. see Mankad *et al*., 2010). Based on self-determination theory principles, it is argued that messages coming from an institution such as the government could negatively impact perceptions of autonomy among certain sections of the population. Individuals with mandated rainwater tanks are more likely to be susceptible

to this effect, simply because the decision to have a rainwater tank in their home was guided by a government mandate, regardless of whether the homeowner wanted this system implemented. The mandate stipulates that not only must the house have a tank, but it outlines the minimum volume of the tank, the fixtures that the tank must be connected to (e.g. toilet, washing machine) and also, how the tank must be set up on one's property (eg. connected roof area, mains water top-up). These strict guidelines remove much of the "decision" factor for individuals building and buying new homes, thus interfering with the important motivational driver of autonomy.

Pelletier and colleagues (e.g. Pelletier *et al.*, 1997; Lavergne *et al.*, 2010) have conducted several studies examining the influence of government on perceptions of autonomy with respect to general pro-environmental behaviours. They measured three main aspects of autonomy: government's support of individuals' autonomy; its use of pressure and control regarding environmental issues; and provision of information to citizens. The results supported their three-factor autonomy structure and, in general, perceptions of autonomy from government positively influenced self-determination with regards to engaging in pro-environmental behaviours. While this research did not specifically focus on water conservation practices such as decentralised water harvesting, Pelletier and colleagues' findings suggest interesting implications for the decentralised system context. Thus, measures of government style (see section 2.2.3) will be used in the present study to examine the role of perceptions of autonomy in predicting regularity of tank maintenance among mandated users of rainwater tanks.

1.3. Hypotheses

In the present study, it was hypothesised that perceptions of competence and autonomy would influence participants' reported regularity of tank maintenance. Specifically, those who perceived themselves as having greater competence with respect to maintaining their tanks would report greater regularity of maintenance behaviour. Participants who perceived a greater sense of autonomy from the government would also report engaging in more frequent tank maintenance. Similar hypotheses were developed for the variables of perceptions of tank ownership and personal history. Individuals who felt a greater sense of ownership of their rainwater tank would report engaging in more maintenance behaviours, as would people who had past experience with owning or using a rainwater tank. The hypothesised psychosocial relationships are represented in Figure 1.

In addition to these primary hypotheses, the present study was also interested in gaining a general description of homeowners' attitudes towards rainwater and how all of these may relate to regularity of tank maintenance. General psychosocial attitudes being explored included acceptability of rainwater for particular domestic uses and satisfaction with the water supplied by the tank. Further, based on anecdotal feedback from water administrators and engineers, researchers were interested in exploring homeowners' perceptions of private/public responsibility regarding tank maintenance, as well as mandated tank owners' willingness to pay external parties to maintain their rainwater tank. These investigations were exploratory in nature, thus there were no specific hypotheses for general psychosocial attitudes towards rainwater, perceptions of responsibility or willingness to pay.

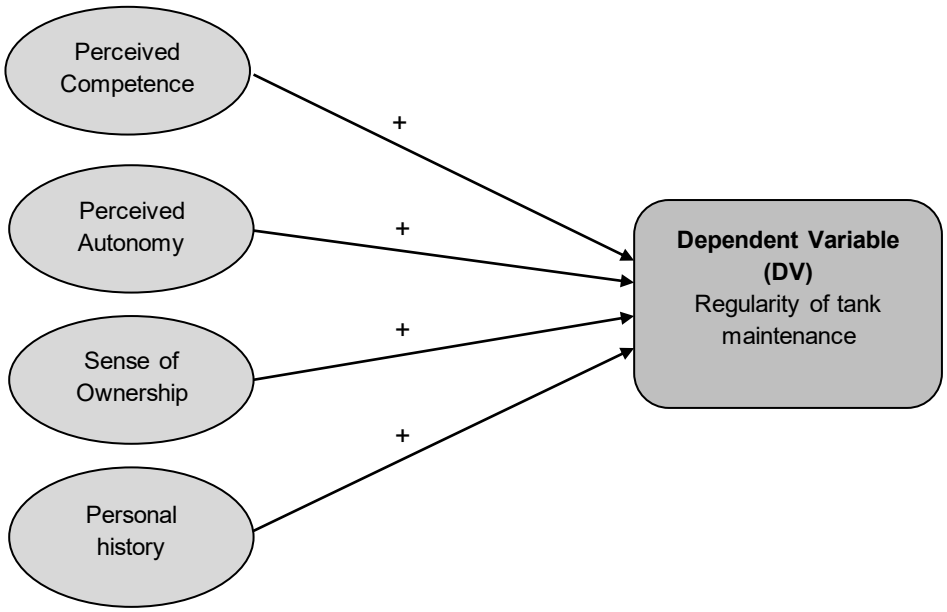

Figure 1: Hypotheses utilising regularity of tank maintenance as the dependent variable (+ denotes the direction of hypothesised relationship).

Secondary hypotheses were also developed, focusing on the role of personal history with rainwater tanks among mandated participants. It was hypothesised that individuals with experience using rainwater tanks as children or adults, in either rural or urban settings, would report greater perceptions of competence with respect to tank maintenance; in this instance perceptions of competence measures were utilised as a dependent variable (Figure 2).

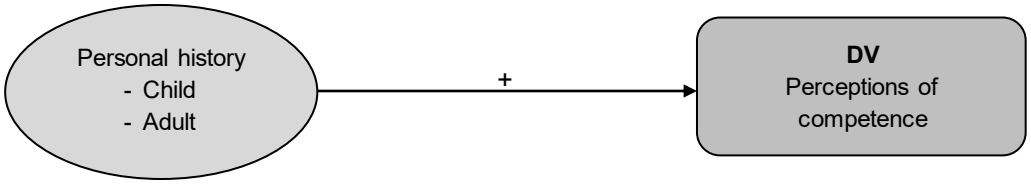

Figure 2: Hypothesised relationship between personal history as predictor of perceived competence of tank maintenance (+ denotes the direction of hypothesised relationship).

It is believed that SDT can: help researchers to answer important questions surrounding motivational drivers for the use of decentralised systems; highlight ways in which psychological factors can be targeted in future interventions to increase uptake of decentralised technology at the household level; and improve ways in which decentralised systems are currently being used in urban homes.

2. METHODS

2.1. Participants

Participants comprised 754 residents from four Local Government Areas (LGAs) in SEQ. The four LGAs were Caboolture, Pine Rivers, Gold Coast and Sunshine Coast. These homes were new dwellings built from 2008 onwards, and had internally plumbed rainwater tanks on-site, as per QDC MP 4.2. Participants were randomly selected from a larger database of households known to have applied for new water accounts (filtered to include only new dwellings) from 2007 onwards, as it was assumed that any new water accounts opened from 2007 would include mandated rainwater tanks.

2.2. Measures

The survey began by sorting participants as *mandated tank owners* (e.g. "do you have a rainwater tank?", "are you the owner of the dwelling you are currently living in?", "when was your house built?") or as *other*. Those who qualified as *other* were not required for this study, therefore, their data were not utilised in the present analysis.

Eligible participants then received a survey booklet (attached in Appendix), comprising physical questions (e.g. tank size and set-up, maintenance schedule, household installations), psychological constructs (e.g. perceived competence, perceived autonomy, perceptions of ownership and choice, personal history), and demographic items (e.g. age, gender, income, occupation).

2.2.1. Physical Measures

In this section of questions, participants were asked to provide information related to the mains and tank water set-up on their properties (e.g. "how large is your rainwater tank?", "is your tank connected to mains water?", "is the tank connected to a pump?", "is the tank plumbed into the house?", "what proportion of roof area is connected to the tank?"). Participants were also asked to clarify whether their home had a supply of recycled water or greywater system connected to internal or external fixtures.

Participants were asked to identify what purposes their rainwater was used for (e.g. "toilet flushing", "clothes washing", "garden irrigation", "drinking/cooking", etc.) and were also asked to estimate how much of their household's total water use was from the rainwater supply. Relatedly, participants also indicated how often they used their rainwater (e.g. daily, weekly, monthly) to allow researchers to get some idea of how familiar participants were with using their tank water. Several other physical items were also included in this section, to provide a description of the types of water appliances and fixtures installed in the home (e.g. low-flow taps and shower heads, trigger nozzle hose, dual flush toilets, etc.), to gain a holistic understanding of the rainwater tank setup conditions in each home.

2.2.2. Perceived Competence

The perceived competence scale used in this study is a four-item scale modified from the original perceived competence for health scale developed by Deci and Ryan (1985). Four items measured participants' confidence and perceived capability in maintaining their rainwater tank and demonstrated high internal reliability (Cronbach's[*] α = .92). Participants responded to each item using a 5-point Likert scale (1 = Not at all true, 5 = Very true), which is a popular scaling response format used to measure attitudinal variables (Likert, 1932).

2.2.3. Perceived Autonomy

Perceptions of autonomy were measured using three subscales from the Government Style Questionnaire (Green-Demers *et al.*, 1994): perceived government autonomy support (e.g. "The government gives me the freedom to make my own decisions about my rainwater tank"), perceived involvement of the government in terms of relatedness support (e.g. "I think the government is

[*] A Cronbach's alpha (α) of .7 and above is considered to be representative of a psychometric measure with high internal consistency and reliability (Nunnally, 1978). This indicates a good psychometric measure.

sincerely focused on water issues in my region of SEQ"), and perceived government control (e.g. "I think the government puts a lot of pressure on people to have rainwater tanks"). Participants were asked to indicate the extent to which they agreed with the 12 items, and responses were made using a 5-point Likert scale (1 = Not at all true, 5 = Very true). The overall autonomy scale achieved a reliability of Cronbach's $\alpha = .71$.

2.2.4. Perceptions of Ownership

This scale was developed based on a summary of related literature on perceptions of ownership in psychology and previous decentralised systems work. Items included: questions about tanks and their influence on mains water consumption (e.g. "I am saving mains water by using rainwater from my tank"); owning a tank and its effects on overall water use at home (e.g. "Because I have a rainwater tank, I don't have to worry about how much water I use at home"); tanks and rainwater as personal resources (e.g. "Rainwater is my own personal water resource"); and acceptability of rainwater for personal use (e.g. "Rainwater is appropriate for use outdoors"). There were 12 items overall and participants were asked to indicate the extent to which they agreed with each statement using a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree; Cronbach's $\alpha = .72$).

2.2.5. Water Culture

Ten items measuring perceptions of water culture were devised based on past social research on decentralised systems (e.g. see Mankad *et al.*, 2010). This set of items asked questions related to perceptions of a *common culture* and the *shared experience* of using tanks (e.g. "In Australia, it is common for people to use rainwater tanks", "Rainwater tanks are a significant part of Australia's culture"), as well as questions relating to a new, emerging water culture (e.g. "I use less water at home now than I did 10 years ago", "Australians don't use water in the carefree way they once did"). Participants responded to the 10 water culture statements using a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree; Cronbach's $\alpha = .72$).

2.2.6. Demographics and Other Psychosocial Measures

Several descriptive items were required to provide an understanding of the people participating in this survey and their personal history. Basic demographic data, such as age, gender, income, occupation, education and ethnicity were collected, as well as a measure of key household characteristics, including household occupancy (i.e. number of adults and children) and dwelling structure. Participants were also asked to describe their personal history, with respect to rainwater tanks. They were asked whether, as a child or as an adult, they had ever lived on a property that used a rainwater tank and, if so, where the property was located and what the tank water was used for. This grouping variable, labelled *personal history,* serves as a grouping variable in some of the subsequent data analyses (see Section 3.3.3).

Other psychosocial descriptors in the survey included a set of six items asking participants to rate their level of satisfaction with factors associated with their tank and rainwater (e.g. size of tank, colour and smell of rainwater, amount of tank maintenance needs, potential health risks associated with tanks). Participants responded using a 5-point Likert scale (1 = Not happy at all, 5 = Very happy; Cronbach's $\alpha = .74$). This set of questions was included merely to gain an understanding of how happy residents were with their rainwater supply; *satisfaction* was not used as a predictor of tank maintenance in this study. Participants were also asked to rate their level of willingness to use rainwater as a replacement for mains water for some household uses (e.g. watering garden, laundry and toilet needs, cooking/drinking). Again, these questions were included for descriptive purposes and responses were made using a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). No Cronbach alpha value was calculated for this variable due to the low number of items.

Finally, participants were asked who they believed should be responsible for maintaining their rainwater tank (i.e. self, local council, water utility, professional maintenance contractor, plumber, self and council, or other) and how much they would be willing to pay for someone to come and maintain their tank upon request (e.g. $100 or less, $101-300 and so on, up to $1,000). Participants were also given the option to select "I'm not willing to pay anything at all". Again, no Cronbach alpha statistics were calculated for these variables, as the response scale was nominal.

2.2.7. Rainwater Tank Maintenance

The primary dependent variable in this study was *regularity of rainwater tank maintenance* (see Section 3.3.2). In this set of items, participants were asked to provide an indication of how frequently they carried out particular tasks on a rainwater tank maintenance schedule. These tasks included checking and cleaning the first flush device, checking mosquito screens and repairing holes and other damage, inspecting and clearing gutters, checking pipes for structural integrity, etc. All tasks were described using a specific time frame (e.g., "check mosquito-proof screen… *every 6 months*", "check for evidence of bird or animal access…*every 3 months*"), so that participants could indicate whether their maintenance behaviour aligned with the correct maintenance guidelines. The response scale was a 5-point Likert scale (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Almost always, 5 = Always). For each of the 13 maintenance behaviours, frequency recommendations were established through Australian Government guidelines (DHA, 2004; Queensland Health, 2007).

2.3. Procedure

To recruit participants, a three-stage survey campaign was launched, targeting 6,100 homes across the four target LGAs in SEQ. The first stage of the campaign involved sending out introductory postcards, where residents of the target households received information about an upcoming survey that they would receive in the mail. One week later, a survey packet was mailed to the same households, comprising a study Information Sheet, a 15-page survey booklet (with detachable Consent Form) and a reply paid envelope. Token incentives were also included in the survey packet, as per Dillman's (2007) method of increasing response rates for mailout surveys. These incentives included two branded organic teabags and a recyclable Eco-pen. Two weeks after the survey packet was sent out, a general reminder postcard was sent to all households, reminding people to return their surveys if they were still keen to participate and thanking those who had already submitted their surveys.

Participants were given approximately six weeks to return their completed surveys to the research team. Returned surveys were collated and given a coded identification number. Consent Forms were detached from the survey booklet and stored confidentially in a separate location, away from the survey data. Data entry was done by an external contractor using a predetermined coding protocol, so as to minimise bias. All data were entered into an Excel file and converted to a Predictive Analytics Software (PASW) Statistics format for subsequent statistical analyses.

2.4. Data Analysis

The data file was cleaned to make sure all variables contained valid responses. Physical data were analysed using Microsoft Excel and all other data (demographic, psychological) were analysed using the PASW Statistics 18 program (formerly known as SPSS). The types of analyses conducted on the data set included descriptive analysis, analyses of variance, and multiple regression analysis.

There were some missing data present within the overall data set, however, no variables sustained greater than 5% missing data and the data missing was shown to be random. Therefore, the effect of missing data was not considered to be problematic for simple descriptive and comparative analyses (Cohen and Cohen, 1983; Tabachnik and Fidell, 2007). However, it was noted that for more complex data analyses being carried out on the psychological variables (i.e. analysis of variance, multiple regression analysis), missing data could be problematic as it may violate some statistical assumptions. Therefore, a missing data replacement technique was used to replace the missing data for psychological variables in the analysis (competence, autonomy, ownership, choice and culture). Again, in all cases, the proportion of missing data for these psychosocial constructs was less than 5%, making the use of data replacement acceptable. The technique used was Expectation Maximisation (EM), a form of Maximum Likelihood estimation, and was undertaken in the PASW Statistics 18 program (see Graham *et al.*, 1997 for an analysis on EM acceptability).

3. RESULTS

3.1. Demographics

Of the 754 participants in this study, 55% were males and 45% were females, aged primarily between 36-45 years (23%), 46-55 years (21%) and 56-65 years (20%). In terms of ethnicity, 83% of participants identified themselves as Anglo-European, with the next highest category comprising those identifying themselves as Asian/Sub-continental (4%). The majority of households were made up of two adults (71%) and approximately 57% of households also reported having no children under the age of 18.

The highest level of education that most people had achieved was high school (30%), Trade/TAFE (31%) or Tertiary undergraduate (22%). With respect to household income, 22% of participating households earned between $60,000-$89,999 and the next populated income bracket was $90,000-$119,999 (15%). In terms of occupation, participants describing themselves as "professionals" comprised 22% of the sample and 22% of participants self-reported as being "retired". The majority of respondents reported using their rainwater daily (89%), though some (7%) reported using it weekly.

3.2. Physical Factors

The specifications outlined in QDC MP 4.2 are prescribed as basic knowledge of mandated rainwater tanks and it is assumed that the homeowners should have knowledge of these biophysical set-ups to some extent, thus we can evaluate their competencies toward rainwater tank maintenance.

Surprisingly, of the 754 participants in this study, only 61% knew that their rainwater tanks were connected to mains water for back-up supply, whereas the remainder (39%) either did not know or were not sure of such technical aspects of their mandated tanks. The percentage distribution of the homeowners' responses is shown in Figure 3.

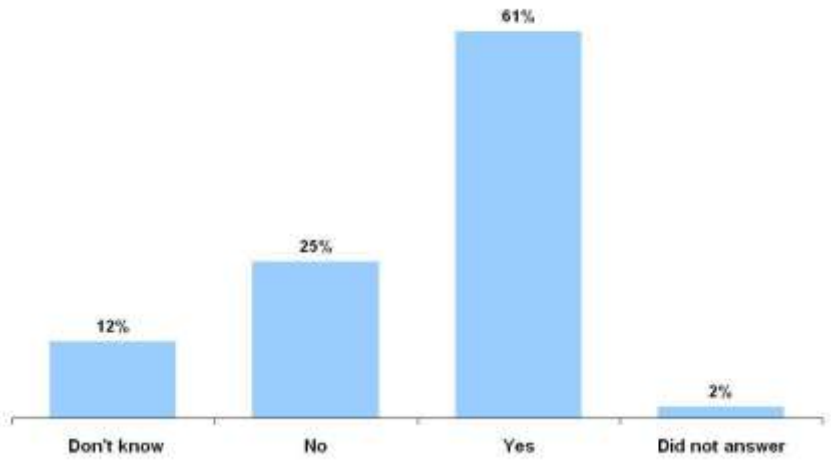

Figure 3: Homeowners' knowledge of mains water top-up in their mandated tanks (n=754).

This is further analysed in Figure 4 using a Histogram analysis. The 39% of homeowners who did not know that a back-up supply for their tank existed were correlated with their completed tank maintenance score (from Question 26 in the survey). In this instance, the tank maintenance scores equated to: 0 (not applicable); 1 (never); 2 (rarely); 3 (sometimes); 4 (almost always) and 5 (always). This was carried out to further confirm that homeowners who were not aware of mains water top-up did not regularly maintain their rainwater tanks. It can be seen that the histogram analysis on lack of homeowners' knowledge was well-correlated with the degree of tank maintenance. It was validated and confirmed via this analysis that a significantly high proportion (80%) of mandated tank owners who did not know about a mains top-up supply scored a tank maintenance score equal to or less than three.

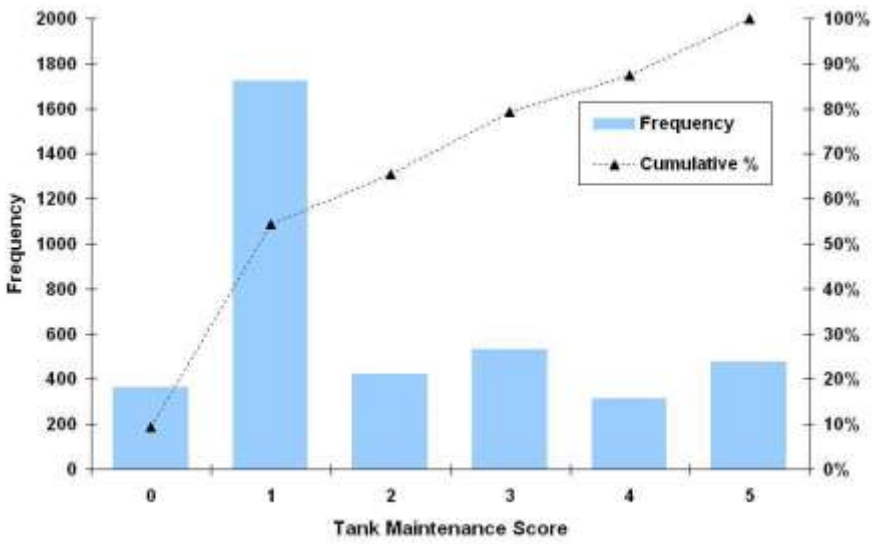

Figure 4: Histogram analysis on homeowners who do not know the mains water top-up in their mandated tanks against surveyed tank maintenance score.

Figure 5 also shows that a significantly high proportion of participants (45%) were not aware of any *trickle* top-up or *automatic switching device* installed on their tanks to allow mains water flows and top-up into their rainwater tanks. In this instance, it is believed that, as anticipated, homeowners without any knowledge of the back-up supply from mains water might not be maintaining their tanks to the standard requirements.

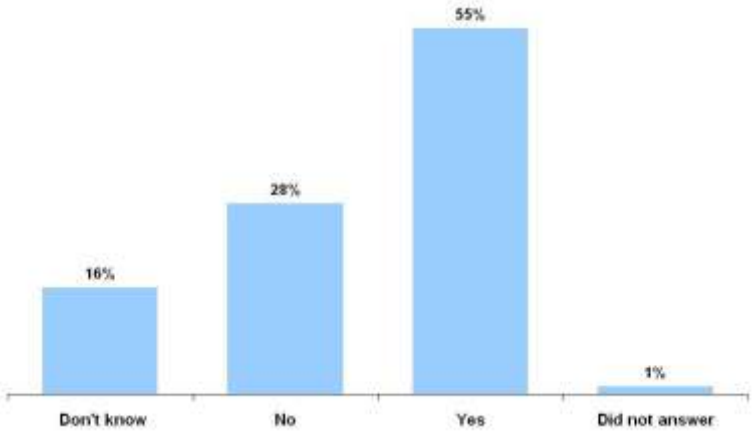

Figure 5: Homeowners' knowledge of the existence of switching valve/trickle top-up system (n=754).

Regular maintenance of this top-up function by homeowners is required to ensure that the mains water top-up systems are functioning properly. Failure of this feature will cause significant usage of mains water, due to (1) continuous delivery of mains water supply into the tank; (2) ineffective capture of rainwater during wet weather events due to constant fill-up by mains water, which will result in tank overflow events to stormwater drains; or (3) a period of no water supply from the rainwater tanks during no rainfall days because of the failure of mains water top-up, which might have a direct operational impact on the rainwater pump systems.

Other information relating to knowledge of physical factors obtained from the survey data included knowledge of the size/volume of participants' rainwater tanks and the connection of rainwater tanks to a pump. Results indicated that most participants (76%) knew the size/volume of their rainwater tanks and that only 14% of participants did not know these specifications. Similarly, a high proportion (95%) of participants stated that their tanks were connected to pumps and only 5% were not aware of this. With respect to households' plumbed-in connections for their rainwater tanks, there was a small proportion of participants who were unaware of the rainwater supply connections to toilet flushing (10%), clothes washing (13%) and garden irrigation (22%).

In summary, results indicate that there is a proportion of participants who are unaware of their household rainwater tank setup and operation, particularly using mains water back-up during rainwater unavailability. Understanding and knowledge of rainwater tank set-up is a critical aspect for tank maintenance, as the failure to attend to such a device might reduce the capacity of rainwater tanks to provide alternative water to augment the mains water sources at the mandated households.

3.3. Psychosocial Factors

The psychological and general social results are presented based on relevant themes. Overall, these findings provide an insight into how people think about rainwater tanks, rainwater itself, and tank maintenance.

3.3.1. General Attitudinal Beliefs about Rainwater

Overall, approximately 96% of participants agreed or strongly agreed that rainwater could be used for some household uses (e.g. washing clothes, toilet flushing), indicating high acceptance for rainwater as an alternative water source. More specific results indicated that 90% of participants would be very willing to use rainwater for their garden and 89% of participants reported being very willing to use rainwater for their laundry and toilets flushing. In terms of acceptability of rainwater for direct and indirect potable applications (i.e. drinking and/or cooking), 42% of respondents said that they would be very willing to use rainwater, 21% were not sure and 12% reported that they would not be willing at all to use rainwater for drinking or cooking.

Table 1 describes participants' level of satisfaction with aspects of the rainwater collected in their tanks. The majority of respondents were very happy/satisfied with their tank size and the quality of water being supplied through the tank. Interestingly, of those who had tasted their rainwater, a significant proportion was satisfied with the taste. However, the high number of participants who had not tasted their rainwater is not surprising, given that using tank water for direct or indirect applications is not part of the rainwater tank mandate and thus, most people are unlikely to consume this water. Refer to Mankad and Tapsuwan (2011) or Mankad *et al*. (2010) for discussions of potential reasons why people may be unlikely to consume rainwater.

Table 1: Percentage of respondents who were happy or very happy with rainwater and tank-related aspects.

Description	% Unhappy	% Neither Happy or Unhappy	% Happy
The size of your tank	12	21	67
The amount of rainwater collected	11	14	75
The colour of your rainwater	2	9	89
The smell of your rainwater	2	8	90
The taste of your rainwater*	5	13	39
The amount of maintenance the tank needs	6	21	73
The potential health risks from mosquitoes or bacteria	12	26	62

* 43% participants answered "not applicable" for this question, indicating that they had never tasted their rainwater

3.3.1.1 Total Rainwater Use

Participants were asked to estimate how much of their household water supply (including outdoor use) came from rainwater. 33% of respondents believed that up to one quarter of their household water was supplied by the rainwater tank, 31% believed that between 25-50% of household water was sourced from their rainwater tank and 4% of participants believed that over 75% of their household water was sourced from rainwater. Approximately 16% of participants said that they didn't know how much of their household water originated from their rainwater tank.

A one-way between-groups analysis of variance (ANOVA) was conducted to examine the influence of perceptions of total rainwater use on participants' regularity of rainwater tank maintenance. The ANOVA test uses the F-distribution (probability distribution) to compare the variances between the

groupings of populations to help determine whether the variability between groups is significantly different. Participants were divided into seven groups, based on their perceived percentage of total household rainwater use (Group 1: 0%, Group 2: up to 25%, Group 3: 25-50%, Group 4: 50-75%, Group 5: over 75%, Group 6: 100%, Group 7: Don't know). Results showed that means significantly differed between groups of individuals who believed that their household used varying amounts of rainwater, F (6, 737)[†] = 5.124, p < .001, indicating that regular tank maintenance varied as a function of perceived total rainwater use. The effect size (i.e. magnitude of the significant difference) for this result was small, but was approaching a moderate size (η^2 = .04).

Post-hoc comparisons using the Tukey HSD test[‡] indicated that those who did not believe much of their household water was from a rainwater tank, or those who did not know how much of their household water originated from a tank, maintained their rainwater tanks significantly less frequently than those who reported that a large proportion of their household water was rainwater (Table 2). That is, people who perceived their household as using more rainwater were more vigilant in maintaining their rainwater tank(s).

The analysis listed in Table 2 describes the group comparisons that were significantly different from each other. For example, the first row of Table 2 shows that the people who believed that they utilised 0% of their total rainwater use significantly differed in their maintenance habits from those people who believed that they utilised 100% of their rainwater. The comparisons that were considered significant all had p-values less than .05 (a standard statistical significance benchmark; Tabachnick and Fidell, 2007).

Table 2: Significant results from post-hoc group comparisons: differences in mean scores for regularity of tank maintenance among those with different perceptions of total household rainwater use.

Group Comparisons*	Mean Difference in Scores	Significance (p)
0% vs. 100%	-14.51	.048
Up to 25% vs. 100%	-12.79	.038
Don't know vs. 50-75% rainwater use	-7.78	.001
Don't know vs. 100%	-16.40	.003

* All other comparisons were non-significant (ie. p > .05) and thus, not reported here for brevity.

3.3.1.2 Perceptions of Responsibility of Maintenance and Willingness to Pay

When asked "who should be responsible for maintaining your rainwater tank", 57% of participants preferred to look after their tanks themselves. Alternatively, 6% felt that the local council should be responsible, 4% cited the water utility, 7% believed a professional maintenance contractor should be responsible, and 25% believe that tank maintenance should be carried out by both the individual and the council. Only 1% of participants cited preferring a plumber as being responsible for tank maintenance.

A one-way between-groups ANOVA was conducted to examine the influence of perceptions of responsibility of maintenance on participants' regularity of tank maintenance. Participants were divided into seven groups, based on who they believed should be responsible for maintaining their rainwater tank (Group 1: Self, Group 2: Local council, Group 3: Water utility, Group 4: Professional maintenance contractor, Group 5: Plumber, Group 6: Self + Council, Group 7: Other). Results showed that mean scores for regularity of rainwater tank maintenance differed significantly between individuals based on who they believed should be responsible for tank maintenance, F_{Welch}[§] (6, 53.03) = 6.08, p <.001, η^2 = .04.

[†] The two numbers in parentheses refer to degrees of freedom (number of independent values in final calculation that are free to vary) and they are dependent on sample size; F values that are different from 1.0 indicate differences between variables (e.g. 'perceptions of total rainwater use' and 'tank maintenance') and larger F values are less common; p values indicate the probability of getting a calculated F value that large, or larger, with $p \leq .05$ used as a standard indicator of a significant effect.

[‡] The Tukey HSD test is a multiple comparison procedure used in conjunction with an ANOVA; it compares all possible pairs of means to determine which means are significantly different from each other (Lowry, 2012).

[§] Welch's F is reported if the assumption of homogeneity of variance is violated for the regular ANOVA. In this case, reporting F_{Welch} means that we avoid reporting an inaccurate P-value, thus decreasing the probability of reporting a falsely significant result.

Post-hoc comparisons indicated that there was only a significant difference in the regularity of tank maintenance scores between those who believed the self should be responsible for maintenance (M = 30.03, SD = 13.48) and those who believed that the water utility should maintain tanks (M = 20.68, SD = 8.76). All other comparisons were non-significant.

To complement these findings, participants were asked how much they would be willing to pay for someone to come and maintain their tank upon request. Approximately 42% of respondents said that they would be willing to pay $100 or less, 19% would be willing to pay $101-$300, and only 2% said they would be willing to pay more than $300. Interestingly, a high percentage of respondents (37%) said that they would not be willing to pay anything at all for someone to come and maintain their tank.

3.3.2. Perceived Competence and Autonomy

The ability of the psychological variables to explain variance in regularity of rainwater tank maintenance scores was evaluated by a standard multiple regression analysis. All subscales comprising the constructs of competence, autonomy, ownership and culture were added simultaneously into the model. Results showed that the full model was significant, F (10, 743) = 24.71, $p < .001$ and the overall psychological model explained 25% of the variance in regularity of tank maintenance scores. Out of the full model, only three subscales were found to be significantly influential predictors of regularity of tank maintenance (see Table 3) and of these, competence achieved a much higher beta (β) score than the two autonomy subscales, indicating its strength as a predictor.

Table 3: Standardised coefficient scores (β) from the full multiple regression model, showing significant individual predictors of regularity of tank maintenance.

Subscale	β	t	Sig. (p)
Competence	.467	12.25	<.001
Autonomy support	.096	3.60	.009
Relatedness support	-.088	-2.38	.018

When each of the psychological constructs was modelled separately with the dependent variable, to examine its independent influence on the prediction of tank maintenance behaviour, only *competence* was a notable predictor on its own, F (1, 752) = 227.50, $p < .001$. Competence, alone, explained 24% of the variance in regularity of tank maintenance scores. Although *autonomy* was also found to be significant as an independent factor in the multiple regression model, it only accounted for 4% of the variance in tank maintenance behaviour.

These results indicate that despite the full model being significant (i.e. all psychological variables entered simultaneously), perceptions of competence account for almost all of the variance found in the regularity of tank maintenance scores. Further, competence explains significantly more variance in one's tank maintenance behaviour than all of the other psychological factors examined in this analysis, including autonomy.

3.3.3. Personal History

It was of interest in the present study to examine the influence of participants' personal history with rainwater tanks when understanding their current tank maintenance behaviour. Participants were asked to indicate whether they had ever lived on a property (rural or urban) with a rainwater tank in the past. The two distinctions in personal history were: experience with tanks as a child, *personal history (child)*; and experience with rainwater tanks as an adult, *personal history (adult)*. Two 2-way between-groups ANOVAs were conducted, testing the influence of *personal history (child)* and *personal history (adult)* on both perceptions of competence (1) and regularity of tank maintenance (2). Each personal history variable comprised four groups (Group 1: No history, Group 2: Experience at rural property, Group 3: Experience at urban property, Group 4: Experience at other type of property).

Results from the first 2-way ANOVA, with *perceptions of competence* serving as the dependent variable, indicated that there was a statistically significant main effect for *personal history (child)* on

perceptions of competence, F (3, 731) = 2.65, $p < .001$, partial $\eta^2 = .01$, as well as a significant main effect for *personal history (adult)* on perceptions of competence, F (3, 731) = 4.16, $p < .006$, partial $\eta^2 = .02$. However, it is important to note that for both of these main effects there were small effect sizes, suggesting the real influence of personal history on perceptions of competence is minimal.

Post-hoc comparisons using the Tukey HSD test indicated that there were some significant differences between groups for each of the personal history variables, presented in Table 4. The comparisons suggest that participants who had past experiences with rainwater tanks as children and/or as adults perceived themselves to have greater competence related to rainwater tank maintenance than those who did not have this past personal experience.

Table 4: Significant results from post-hoc group comparisons: differences in perceptions of competence among those with differing personal histories with rainwater tanks.

Group Comparisons*	Mean Differences in Scores	Significance (*p*)
PERSONAL HISTORY (CHILD)		
No history vs. Experience at rural property	-1.28	.005
No history vs. Experience at urban property	-1.79	.008
PERSONAL HISTORY (ADULT)		
No history vs. Experience at rural property	-2.67	<.001
No history vs. Experience at urban property	-2.48	<.001
Experience at rural property vs. Experience at urban property	4.20	.042

* All other comparisons were non-significant and thus, not reported here.

The second 2-way ANOVA utilised *regularity of tank maintenance* as the dependent variable. Results showed a statistically significant main effect for the influence of *personal history (adult)* on regularity of tank maintenance scores, F (3, 731) = 3.44, p = .017, partial $\eta^2 = .01$. Once again, the effect size for this finding was low. There was no significant main effect present for the influence of *personal history (child)* on regularity of tank maintenance. Post-hoc comparisons of the single main effect for personal history (adult) indicated that there were significant differences in regularity of tank maintenance scores between those who did not have past experience living with a tank and those who did have this experience as an adult. For example, the first comparison listed under *PERSONAL HISTORY (ADULT)* in Table 5 indicates that people grouped as having no personal history with rainwater tanks as an adult reported significantly different regularity in their tank maintenance when compared to those who were grouped as having experience of rainwater tanks at a rural property as adults.

Table 5: Significant results from post-hoc group comparisons in regularity of tank maintenance among participants with a personal history living with a rainwater tank as an adult.

Group Comparisons*	Mean Differences in Scores	Significance (*p*)
PERSONAL HISTORY (ADULT)		
No history vs. Experience at rural property	-1.28	.005
No history vs. Experience at urban property	-1.79	.008

* All other comparisons were non-significant and thus, not reported here.

All the other psychological variables were also tested in 2-way ANOVAs, to determine if personal history with rainwater tanks as a child or as an adult influenced responses on these factors (i.e. perceptions of tank culture and tank ownership). However, the influence of personal history on tank culture and perceptions of ownership were not found to be significant, thus those results are not reported here.

4. DISCUSSION

As discussed in the SEQ Water Strategy (2010), the effective integration and implementation of mandated rainwater tanks as domestic decentralised water systems is expected to augment 7% of predicted water demand in SEQ by 2056. However, the duration and effectiveness of a rainwater tank depends largely on various psychosocial factors specific to homeowners and their maintenance attitudes and behaviours. These factors can also likely predict continued homeowner maintenance of tank equipment over its entire lifespan. Results from this study indicate that not every homeowner knows how their rainwater tank is physically set up, or how to maintain their mandated rainwater tank properly. A high proportion of mandated tank owners, approximately 40%, reported not knowing that their tank was being backed up by mains water when the tank water level ran low. Further analyses indicated that this particular group of mandated tank owners also rarely maintained their rainwater tanks. Gardner and Vieritz (2010) discussed that a lower level of knowledge may exist among residents with mandated rainwater tanks due to the mandatory nature of the legislation enforced by local governments relative to new homes in SEQ. This may reduce homeowners' motivation to actively engage with duties associated with their rainwater tank and result in poorer maintenance outcomes. The present study argues that a basic understanding of the physical setup of mandated tanks, and the confidence to engage with one's tank, is essential in motivating regular tank maintenance behaviour among mandated tank owners.

The most significant finding in the current study related to mandated participants' perceptions of competence and autonomy with respect to maintaining their rainwater tanks. Statistical analyses revealed that these two self-determination variables explained 25% of the variance in tank maintenance behaviours, which is a high-moderate amount explained in the field of psychological science, given the difficulties in explaining human behaviour (Tabachnik and Fidell, 2007). Results showed that higher perceptions of autonomy support were related to a greater regularity in reported maintenance behaviours. Participants who perceived the government as supportive in allowing citizens the freedom to make their own decisions about installing a rainwater tank tended to engage more when maintaining their tank. However, it was the competence variable that was the most influential when explaining tank maintenance behaviour, with participants reporting higher perceptions of competence as related to a greater regularity of tank maintenance. That is, those homeowners who felt confident in their ability to maintain a tank and felt capable of handling the required maintenance duties reported performing significantly more tank maintenance activities more often.

Perceptions of competence revolve around feelings of confidence in one's ability and capability to maintain the system (i.e., self-efficacy). The primary role that competence plays in encouraging greater public engagement with rainwater tanks has important implications for future work to enhance the number of homes with workable rainwater tanks now, and in the future.

It is recommended from this research that ways in which water stakeholders could look to target perceptions of competence would be through applied public education campaigns and small-scale interventions. Mankad and colleagues (2010, 2011) reported that few owners of mandated rainwater tanks are provided with instructions and guidelines as to how to take care of their rainwater tank and, in most cases, this information is only sourced if the individual is motivated to do so. A public education campaign for all new homeowners is likely to foster greater feelings of comfort and familiarity with rainwater tanks, which is likely to then translate into greater confidence in dealing with maintenance issues. It is believed that this, in turn, will encourage homeowners to carry out maintenance behaviours on their own tanks, or at the very least, recognise when their tank requires maintenance and hire a professional to undertake the work.

Other results from the psychosocial component of this study revealed that most homeowners with mandated rainwater tanks were highly accepting of using rainwater for various non-potable household uses and were satisfied with their rainwater tank systems. A large proportion of participants were also willing to use rainwater for potable applications, such as drinking and cooking, however, a notable proportion of individuals were unsure about using rainwater for human consumption. These findings correspond with past research conducted by Mankad and colleagues (2010), who discussed that among those individuals who only view their tanks as a secondary water supply (e.g., mandated users), their

acceptability of applications for rainwater are limited to non-potable uses. Further, the idea of having a tank as a serviceable piece of household infrastructure seems dependent upon how much they perceived themselves as using it. The present study examined perceptions of water use among mandated tank owners and found that the majority of respondents felt that less than 50% of their household water was rainwater from the tank and most homeowners reported using their rainwater for non-potable applications.

Related to this idea of perceived utility, if a homeowner believes their tank has little utility, then their motivation to regularly maintain it by investing time and money is also reduced. It is recommended that perceptions of tank utility be more closely examined in future decentralised systems research because it appears that utility and efficacy perceptions may be important in motivating maintenance behaviours. This alternative hypothesis is supported by further analyses in the present study, which showed that perceptions of total rainwater use at home was significantly related to regularity of rainwater tank maintenance. Those who perceived their household rainwater consumption as higher (i.e. rainwater comprising a greater total percentage of total household water) were more vigilant in maintaining their rainwater tank.

A secondary aim of the present research was to examine the role of personal history in participants' current interactions with their rainwater tanks. It was found that those participants who had prior personal experience living with a rainwater tank, either as a child or adult, reported themselves as having greater competence when it came to tank maintenance. Whether the individuals had gained this experience in the rural or urban context was not found to be relevant. These experienced individuals, consequently, reported engaging in more regular tank maintenance activities, presumably due to greater familiarity with living with this type of infrastructure. While personal history is an important descriptive variable that can differentiate among mandated tank owners, it is not a factor researchers can necessarily control or manipulate through psychological interventions. Rather, this finding is more informative in understanding the social context within which these issues exist.

The research findings suggest that, while current urban dwellers are unfamiliar with using and maintaining rainwater tanks on their properties, this will not always be the case. If precedence holds, it is likely that future generations will view decentralised infrastructure as the norm in water-stressed urban environments and be comfortable using rainwater and tanks. This is likely to foster greater perceptions of competence and result in more efficient use of the systems. Therefore, the present social context where decentralised systems are seen as unfamiliar infrastructure may likely be an artefact of rapid change where a novel technology has been implemented on a wide and, at times, hastily implemented scale (e.g., see Mankad *et al*., 2010). Researchers can advance this knowledge process by targeting new homeowners and providing that experience through education and communication.

5. CONCLUSIONS

In conclusion, this study has provided an empirical and quantitative understanding of physical and psychosocial factors contributing to the regularity of rainwater tank maintenance among mandated tank owners. Survey results revealed that not all mandated tank owners knew the basic physical setup of their rainwater tanks which, in turn, may have influenced the degree to which they chose to engage in activities associated with using and routinely maintaining their rainwater tank. The most significant finding from the physical tank data was that most homeowners did not know that their tanks were being backed up by mains water supply when the tank water level was running low, through the trickle top-up or automatic switching settings. In this instance, it is foreseeable that a significant amount of effort needs to be carried out by the local government authorities to ensure that every new mandated tank owner is knowledgeable and competent in understanding rainwater consumption, as well as the maintenance of their rainwater tanks. An information campaign describing the common setup and maintenance routines required to maintain their rainwater tanks to a satisfactory condition need to be distributed to encourage or enhance the regularity of tank maintenance. If mandated tank owners are able to frequently maintain their rainwater tanks, the quality of rainwater and the overall lifespan of rainwater tanks will improve. This is likely to also demonstrate to the public that their personal investments, as well as the considerable government incentives and investments, into the domestic rainwater tank scheme will be beneficial in ensuring a long-term cost-effective and secure source of alternative water supply to augment the availability of mains water.

The psychological influence of *perceptions* played a significant and important role in rainwater use and tank maintenance. In particular, perceptions of competence specific to tank maintenance were found to be the most important predictor of regularity in tank maintenance behaviours. It is important to acknowledge that the quality of tank maintenance, in addition to perceptions, was not assessed in the present study; doing so may have provided a useful objective comparison between *actual* maintenance and *perceived* maintenance. However, the focus of this study was to examine psychological factors, therefore, future research could expand on the present findings and look to compare actual maintenance (e.g., observational data) with perceived factors associated with maintenance.

Personal belief that the government was advocating independence among homeowners with respect to rainwater tank installation was also found to predict regularity in tank maintenance, suggesting that homeowners viewed personal choice as important in their tank-related behaviours. In this particular analysis, perceptions of ownership and water culture were not important predictors of competence or tank maintenance. While participants, overall, were highly accepting of rainwater tanks and were satisfied using rainwater for applications around the home, it is interesting to note participants' beliefs surrounding maintenance responsibility. Most participants reported that they would be willing to maintain their rainwater tanks themselves, or have assistance from the local council in combination with self-maintenance. An overwhelming majority were not in favour of having a water utility be responsible for tank maintenance.

These findings, while supplementary to the main research questions, provide an important preliminary guide for future research on decentralised system governance and management in SEQ and other urban areas. No research to date has examined how the public perceives rainwater tank governance. However, it is clear that the public would like greater transparency and information with regards to the use and maintenance of rainwater tanks (e.g. Mankad *et al*., 2011). It is this avenue that should be prioritised in future research, due to the long-term implications.

If maintenance of rainwater tanks is not addressed, particularly in SEQ, then public dissatisfaction with rainwater tanks systems can increase and may hinder the further uptake of rainwater tanks and other alternative water-use options at the household level. With more than 1 million existing tanks across Australia needing maintenance over the longer-term, this has important implications for public health, mains water use and reliability of alternative water supplies.

APPENDIX – SEQ Rainwater Tank Survey

UWSRA Office use only

Urban Water Security Research Alliance

SEQ Rainwater Tank Survey

Please return completed survey <u>in the Reply Paid envelope provided</u> or mail to:

CSIRO Ecosystem Sciences
Level G Block C
SEQ Water Survey
Reply Paid 84366
Brisbane QLD 4001

Queensland Government

National Research FLAGSHIPS Water for a Healthy Country CSIRO

Griffith UNIVERSITY

The University Of Queensland AUSTRALIA

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FORM B: CONSENT FORM

Title of Research Project: Community Perspectives on Household Rainwater Tanks

Your involvement in this study is highly valued. Please review the information below and sign in the box provided if you agree to participate in this study.

This form will be detached from your completed survey and stored in a secure file

I acknowledge that:

- I have agreed to participate in the project.
- I will not be identified personally at any stage of the project and all survey and water use data will be kept confidential, only seen by researchers involved in the research project.
- Questions regarding my participation have been answered to my satisfaction and I am aware that I can obtain further information from the research team at any time during the project.
- I understand that this study has been cleared in accordance with the ethical review process of CSIRO. If I have any questions concerning my participation, I should feel free to contact the researchers involved. I understand that I can also speak to someone at CSIRO not involved in the study, by contacting the CSIRO Human Research Ethics Officer.
- I have been provided with the contact details of the investigating officers (see separate Information sheet).
- I understand that I am able to stop taking part in this study at any time without penalty and without giving an explanation for my withdrawal.
- I understand that I may ask that part or all of my data be removed from the study without penalty or explanation. Survey data that is removed from the study will be deleted and not included in any further investigations.

By signing below, I confirm that I have read and understood the attached Information Sheet and acknowledge that my involvement in this research will include completing a questionnaire and returning it to researchers at CSIRO.

Further, if I allow CSIRO to access my water use records, the specific information to be provided to researchers is water consumption data from the time of house occupation until the end of 2012. I understand that numerical data from household meter readings will be kept confidential and only be used for the purposes of this research.

THANK YOU FOR YOUR PARTICIPATION

<table>
<tr><td>Name:</td><td colspan="4"></td></tr>
<tr><td>Unit No.:</td><td>Street No.:</td><td colspan="2">Street Name:</td><td>Suburb and Postcode:</td></tr>
<tr><td colspan="3">Email:</td><td>Signature:</td><td>Date:</td></tr>
<tr><td colspan="5">If you are <u>not</u> happy for CSIRO to access your past and future water use records for this important research, please tick the box below:
☐ No thank you, I do not want CSIRO to access my water records for this research.

If you would you like to be informed of the results from this study, please tick the appropriate box:
☐ Yes, I would like to be informed of the study results.
☐ Yes, I would like to be contacted about future CSIRO research</td></tr>
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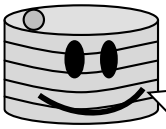


INSTRUCTIONS FOR COMPLETING THE SURVEY

This survey asks for your thoughts and opinions about rainwater tanks, their use and maintenance.

Benefits to you, the participant
Being involved in this large research project means that you will get the opportunity to present your personal views on rainwater tanks to the community, thus contributing to an important area of research in South East Queensland. The knowledge we gain from this survey, at the community level, may help to inform policy regarding rainwater tanks and their maintenance in South East Queensland.

We are interested in the views of all rainwater tank users. Therefore, it does not matter if you perform regular maintenance on your tank, or if you never maintain it at all – everyone's opinion counts.

As many of the survey questions are about using and maintaining the rainwater tank, the survey should be answered by the person in your household who is most familiar with the tank. Please be assured that there are no right or wrong answers in the survey, it is your personal opinion that we are most interested in.

This survey will take approximately 15 minutes to complete.

All your responses will be kept confidential and your information will not be seen by anyone outside the research team.

Short instructions on how to complete the survey:

1. Please read each question carefully. Circle or tick your responses as required for each question.

E.G. *CORRECT METHOD* *INCORRECT METHOD*

1 2 3 4 5 1 2 3 4 5

2. When you reach the end of the survey, please look through the whole survey again to ensure you have not accidentally missed any questions.

3. Please fold the survey and return it to us in the Reply Paid envelope provided.

THANK YOU FOR YOUR TIME

SECTION 1: RAINWATER TANK AND RAINWATER USE QUESTIONS

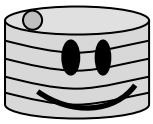
PLEASE NOTE: "Mains water" refers to the primary water supply that homes in SEQ receive through the city council or water utility.

1. **Do you have a rain water tank on your property?**

   ☐ Yes ☐ No (*please go to Section 2, pg.14*) ☐ Don't know/Not sure (*please go to Section 2, pg.14*)

2. **Do you have more than one rainwater tank?**

   ☐ Yes ☐ No ☐ Don't know/Not sure



While you may have more than one rainwater tank on your property, all questions in this survey refer to the tank that you use most often. This is referred to as your 'primary rainwater tank'.

3. **Is your primary rainwater tank connected to mains/town water?**

   ☐ Yes ☐ No ☐ Don't know/Not sure

4. **Are you the owner of the dwelling you are currently living in?**

   ☐ Owner ☐ Paying mortgage ☐ Private renter ☐ Public renter

5. **What best describes your dwelling structure?**

   ☐ Separate house ☐ Semi-detached or town house ☐ Flat, Unit or Apartment

6. **When was your house built?**

   ☐ 2006 or earlier ☐ 2007 ☐ 2008 ☐ 2009 or later ☐ Don't know/Not sure

7. **How large is your primary rainwater tank, in litres (L)?**

   ☐ 5000L or less ☐ 5001L - 9,999L ☐ 10,000L - 19,999L ☐ 20,000L or more

   ☐ Don't know

NOTE: If you have two primary tanks that are connected together, please put the total volume of the tanks.

8. **If your rainwater tank level is low, is there a 'switching valve' or 'tickle top up' device in your primary tank that allows mains water to flow into the tank?**

   ☐ Yes ☐ No ☐ Don't know/Not sure

9. **Is the primary rainwater tank connected to a pump?**

   ☐ Yes ☐ No ☐ Don't know/Not sure

10. **Is the primary rainwater tank plumbed into the house (e.g., connected to laundry tap, toilet flush, outside taps)?**

    ☐ Yes ☐ No ☐ Don't know/Not sure

11. **For what purpose is your rainwater used?** (*you may choose more than one option*)

☐ Toilet flushing ☐ Clothes washing ☐ Garden irrigation ☐ Topping up swimming pool

☐ Drinking/cooking ☐ Car washing ☐ Don't use it at all ☐ Other:_____

12. **Have you ever hired a professional tank cleaner or tank maintenance professional (e.g., plumber)?**

☐ Yes ☐ No ☐ Don't know/Not sure

13. **Approximately what proportion of your roof area is connected to the tank?**

☐1/4 ☐1/2 ☐3/4 ☐All

☐ Don't know/not sure

14. **Do you have recycled water delivered to your home through a purple pipe/tap for toilet flushing, laundry and/or outside taps?**

☐ Yes ☐ No ☐ Don't know/Not sure

15. **Do you have a greywater treatment system that supplies treated water to your toilet, laundry and/or outside taps?**

☐ Yes ☐ No ☐ Don't know/Not sure

16. **Do you have a greywater diversion device installed in your home?**

☐ Yes ☐ No ☐ Don't know/Not sure

17. **Do you have any of the following currently installed and in use within your home:**

(Please tick ☑ one box for each)

Installations	Yes	No	Not sure	Not applicable
a) low-flow taps on all fittings				
b) low-flow shower heads on all fittings				
c) pool cover				
d) hose with trigger nozzle or timed sprinkler				
e) water-wise plants and/or gardens				
f) dual-flush or composting toilet				
g) shower timer				
h) dual flush toilet(s)				
i) water-wise washing machine (ie. has a star rating)				
j) water efficient dishwasher (ie. has a star rating)				
k) hose to divert greywater from washing machine to garden				

18. **In your opinion, approximately how much of your household's total water use (including outside/garden use) comes from your rainwater tank(s)?**

☐ 0% ☐ Up to 25% ☐ 25-50% ☐ 50-75% ☐ Over 75%

☐ 100% ☐ Don't know

19. **While growing up, did you ever live on a property that utilised a rainwater tank?**

☐ Yes, rural or regional property with a tank ☐ Yes, urban/metro property with a tank

☐ Yes, other:_____

☐ No, I never had a rainwater tank while growing up (*please proceed to Question 20*)

a. **If you answered YES to Question 19, what did you use the tank water for:**
(you may select more than one option)

☐ Toilet flushing ☐ Clothes washing ☐ Watering garden/lawn ☐ Topping up swimming pool

☐ Drinking/cooking ☐ Car washing ☐ Other (*Specify*)_____

20. During your adult life, have you ever lived somewhere that utilised a rainwater tank before now?

☐ Yes, rural or regional property with a tank ☐ Yes, urban/metro property with a tank

☐ Yes, other:_____

☐ No, have never had a rainwater tank before now (*please proceed to Question 21*)

a. **If you answered YES to Question 20, what did you use the tank water for:**

☐ Toilet flushing ☐ Clothes washing ☐ Watering garden/lawn ☐ Topping up swimming pool

☐ Drinking/cooking ☐ Car washing ☐ Other (*Specify*)_____

21. If you had a tank in the past, were you told to remove it, or was it removed by the council, due to public health concerns in QLD (eg. mosquito breeding)?

☐ Yes ☐ No ☐ I don't know ☐ I have never had a tank before now

Please circle the most appropriate number for the following questions:

22. How willing are you to use rainwater in the garden?

1	2	3	4	5
Not willing at all		Not sure		Very willing

23. How willing are you to use rainwater inside the house for your laundry and toilet needs?

1	2	3	4	5
Not willing at all		Not sure		Very willing

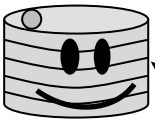
24. How willing are you to use filtered rainwater for drinking and/or cooking?

1	2	3	4	5
Not willing at all		Not sure		Very willing

Please indicate your level of agreement with the following statement:

25. Rainwater can be used to replace mains water for some household uses (eg. washing clothes, toilet flushing)

1	2	3	4	5
Strongly disagree		Neither		Strongly agree



Thanks for your efforts so far! In the following sections, we'd like to know more about you opinions and behaviours related to rainwater tanks. While some questions may feel repetitive, we assure you that each question is important to us.

Remember, there are no right or wrong answers! This survey is all about the things that you choose to do!

26. The following lists a number of maintenance behaviours you can perform on your rainwater tank(s). Please indicate how often you perform each one by ticking ☑ one box for each activity.

Please note, there are no right or wrong answers here.

	Never	Rarely	Sometimes	Almost always	Always	N/A
a) check and clean first flush devices after it rains						
b) check tank mosquito-proof screens and flap valves for rips, holes and defects every 6 months						
c) repair rips, holes and defects on tank when needed						
d) check roof and gutters for accumulated debris, including leaf and other plant material, every 3 months						
e) remove debris from roof and gutters as required						
f) check for evidence of animal, bird or insect access every 3 months						
g) check inside tank for accumulated sediment every 2-3 years						N/A
h) prune overhanging tree branches and foliage as required						N/A
i) preventing entry of light into tanks or pipe work by painting white pipes with a dark colour, if required						N/A
j) inspect gutters and the bottom of tanks every 3 months to determine whether there is pipe work that can contain stagnant water						N/A
k) siphon out the sludge covering the bottom of the tank, or completely empty the tank to remove sludge, as required						N/A
l) check pipes for structural integrity every 12 months						
m) check structural integrity of the tank, including the roof and access cover, every 12 months						

27. How satisfied are you with your primary rainwater tank, in terms of:
(please circle your response for each item)

ITEM	Not happy at all				Very happy	N/A
a) The size of your tank	1	2	3	4	5	
b) The amount of rainwater collected	1	2	3	4	5	
c) The colour of your rainwater	1	2	3	4	5	
d) The smell of your rainwater	1	2	3	4	5	
e) The taste of your rainwater	1	2	3	4	5	N/A
f) The amount of maintenance the tank needs	1	2	3	4	5	
g) The potential health risks from mosquitoes or bacteria	1	2	3	4	5	

Please respond to each of the following statements in terms of how true it is for you with respect to dealing with your rainwater tank(s).

We encourage you to answer all questions openly and honestly, as your responses are confidential.

(*Please circle most appropriate number for each question*).

28. I feel confident in my ability to maintain my rainwater tank.

1	2	3	4	5
Not at all true		Somewhat true		Very true

29. I am capable of handling the maintenance duties required for my rainwater tank.

1	2	3	4	5
Not at all true		Somewhat true		Very true

30. I would be able to do my own rainwater tank maintenance if I had the time.

1	2	3	4	5
Not at all true		Somewhat true		Very true

31. I feel able to meet the challenge of maintaining my rainwater tank.

1	2	3	4	5
Not at all true		Somewhat true		Very true

32. The following statements refer to your opinions about government environmental strategies. When doing so, please focus on SEQ programs and policies.

Please indicate to what extent you agree with the following statements by circling the appropriate response.

STATEMENT	Strongly disagree		Neither		Strongly agree
a) I can choose whether or not to use the strategies prompted by the government to conserve water (eg. taking shorter showers, installing low-flow shower heads).	1	2	3	4	5
b) I think the government puts a lot of pressure on people to have rainwater tanks.	1	2	3	4	5
c) I think the government is sincerely focused on water issues in my region of SEQ.	1	2	3	4	5
d) I do not feel that the government forced me to get a rainwater tank.	1	2	3	4	5
e) I do not feel as though the government imposes its water conservation strategies on us.	1	2	3	4	5
f) I think that the government creates programs to conserve water because it is sincerely concerned with SEQ's future well-being.	1	2	3	4	5
g) I believe the government really has the public's interest at heart when it comes to water conservation issues.	1	2	3	4	5
h) I feel the government wants to make me feel guilty when I do nothing to conserve water.	1	2	3	4	5
i) The government gives me the freedom to make my own decisions about my rainwater tank.	1	2	3	4	5
j) I think the government worries enough about the interests of SEQ, where water conservation is concerned.	1	2	3	4	5
k) I can easily obtain the information I need to use my rainwater tank properly from my local council.	1	2	3	4	5
l) I feel I can choose whether or not to participate in rainwater tank programs established by the government (e.g., building development code guidelines).	1	2	3	4	5

33. To what extent do you agree OR disagree with the following statements?

Please indicate your level of agreement or disagreement by circling the appropriate number.

ITEM	Strongly disagree		Neither		Strongly agree
a) Rainwater tanks provide residents with extra water, so that they are less affected by water restrictions	1	2	3	4	5
b) Rainwater is appropriate for use outdoors (eg. for the garden and lawns)	1	2	3	4	5
c) Because I have a rainwater tank and supply my own rainwater, I feel less guilty about using more water inside and outside the house	1	2	3	4	5
d) Rainwater is appropriate for use indoors (eg. for laundry and toilet flushing)	1	2	3	4	5
e) Now that I have my own rainwater, I am able to have a swimming pool on my property	1	2	3	4	5
f) It is necessary for all new homes, including mine, to have a rainwater tank so that homes are less reliant on mains water	1	2	3	4	5
g) Rainwater is my own personal water resource	1	2	3	4	5
h) Now that I have a rainwater tank, I am able to pursue activities that require more water, such as gardening, because I'm not using mains water	1	2	3	4	5
i) I am saving mains water by using rainwater from my tank	1	2	3	4	5
j) In my opinion, individual homes with a rainwater tank should be allowed to use the rainwater however they want	1	2	3	4	5
k) Rainwater tanks are an effective way for SEQ residents to reduce the amount of mains water that they use at home	1	2	3	4	5
l) Because I have a rainwater tank, I don't have to worry about how much water I use at home	1	2	3	4	5

34. How often do you use your rainwater?

☐ Daily ☐ Weekly ☐ Fortnightly ☐ Monthly ☐ Rarely

You're almost done!! Only a few more questions to go…

PLEASE NOTE: Questions regarding government policy and financial costs associated with rainwater are purely for research purposes. This information will not be used in any other way and <u>will not</u> be passed on to water service providers.

35. To what extent do you agree OR disagree with the following statements?
Please indicate your level of agreement by circling the appropriate number for each item.

ITEM	Strongly disagree				Strongly agree
a) The requirement to install rainwater tanks in new homes should only be compulsory for high water users	1	2	3	4	5
b) Where there is a government requirement to have a tank, the tank should be free (no financial cost)	1	2	3	4	5
c) As a resident of SEQ, I should be allowed to make my own decision as to whether I want a rainwater tank or not	1	2	3	4	5
d) For new homes, the cost of installing a rainwater tank should be means-tested	1	2	3	4	5
e) It should be compulsory for my home to have a rainwater tank, even if my household does not use excessive amounts of mains water	1	2	3	4	5
f) It seems fair to me that all new homeowners in SEQ should pay extra to get a rainwater tank, even if they don't want one	1	2	3	4	5
g) I believe the decision to install a rainwater tank on my property was made by the government	1	2	3	4	5
h) New home owners should get a subsidy to help with the expense of a rainwater tank	1	2	3	4	5
i) I believe that all new homes should have a plumbed rainwater	1	2	3	4	5

36. Who should be responsible for maintaining your rainwater tank?
☐ Self ☐ Local council ☐ Water utility ☐ Professional maintenance contractor
☐ Plumber ☐ Self + council ☐ Other:_____

37. How much, per year, would you be willing to pay for someone to come and maintain your tank at your request?
NOTE: this maintenance would include all the behaviours listed in Question 25.
☐ $100 or less ☐ $101-$300 ☐ $301-$500 ☐ $501-$700 ☐ $701 - $1000
☐ I'm not willing to pay anything at all

38. To what extent do you agree OR disagree with the following statements?

ITEM	Strongly disagree				Strongly agree
a) In Australia, it is common for people to use rainwater tanks	1	2	3	4	5
b) Since the drought affected SEQ, the way I use water has changed forever	1	2	3	4	5
c) Rainwater tanks are a significant part of Australia's culture	1	2	3	4	5
d) I use less water at home now than I did 10 years ago	1	2	3	4	5
e) City people are not familiar with using rainwater tanks	1	2	3	4	5
f) Australians don't use water in the carefree way they once did (e.g., running under the sprinkler, washing driveways with a hose, etc.)	1	2	3	4	5
g) Rainwater tanks only belong in the country, not in the city	1	2	3	4	5
h) Conserving water (e.g., having shorter showers, reusing bathwater) has become a habit for me	1	2	3	4	5
i) Using a rainwater tank on one's property is common in SEQ	1	2	3	4	5
j) I still find it difficult to reduce my water use at home	1	2	3	4	5

SECTION 2: DESCRIPTIVE QUESTIONS

The following questions will allow researchers to get a general idea of the people who took part in this study. When you answer these questions, you will not be identifiable and all information will be kept confidential.

a) Which category best represents your age?

☐ 18-25 years ☐ 26-35 years ☐36-45 years ☐46-55 years ☐56-65 years ☐ Over 65 years ☐Prefer not to respond

b) What is your gender? MALE or FEMALE (please circle one)

c) What is the household's annual income before tax (gross income)?

☐ Less than $30,000 ☐ $30,000-59,999
☐ $60,000-89,999 ☐ $90,000-119,999
☐ $120,000-149,999 ☐ More than $150,000
☐ Prefer not to respond

d) How many people usually live in your home?

No. of Adults (18 and over):_____
No. of Children (under 18 years):_____
Ages of children: _____

e) What is your usual occupation?

☐ Manager ☐ Technician/trade worker
☐ Community/personal service worker ☐ Machine operator/driver
☐ Professional ☐ Labourer
☐ Sales worker ☐ Clerical and administrative workers
☐ Retired ☐ Home duties
☐ Other _____

f) What is the highest level of education you have achieved? (please circle <u>one</u>)

Primary School | High School | Trade/ TAFE | Tertiary Undergraduate | Tertiary Postgraduate

g) Which category <u>best</u> describes your ethnic origin? (please circle <u>one</u>)

Aboriginal/Torres Strait Islander | Anglo-European | Asian/Sub-continental | Polynesian
Middle-Eastern | African | Hispanic | Mixed ethnicity
Other:_____

Lastly, would you be interested in participating in further CSIRO rainwater tank research?
The next phase of this important research is a free rainwater tank inspection, which is part of a larger SEQ Rainwater Tank Study. In this phase, a consultant engaged by CSIRO will carry out a standard checklist assessment of rainwater tanks at selected homes in your local council area. There will be no cost to the householder in carrying out this inspection.

The assessment will incorporate:

(1) characteristics of individual dwellings (eg, dwelling type, total roof area, property dimensions);
(2) choices made in water efficient appliances and fixtures (eg, showerheads, washing machine);
(3) information on the rainwater tank systems (eg, tank volume, roof area connected, pump size);
(4) detailed inspection of internal connections for rainwater supply (eg, plumbing connections to/from the tank); and
(5) other water related features on the property (eg, swimming pool, spa).

The information obtained from this simple assessment will enable CSIRO researchers to understand whether there are any issues with the installation and functioning of rainwater tanks under Queensland Development Code MP4.2.

Benefits to you, if selected for a home audit.
For you, the homeowner, this thorough assessment of your home and tank will be highly beneficial in identifying leaks in the home, checking plumbing connections and obtaining other valuable information on how well your rainwater tank is functioning. The consultant will only require access to the house and garden, without any further imposition on you. If there appears to be any major issue with the installation of your rainwater tank, a project team member will contact you.

The house assessment will be arranged at a suitable time for you and will be conducted by a trained professional.

Not only will this research help CSIRO understand SEQ water use, but it will also provide you with important information about how water is being consumed in <u>your</u> home.

☐ Yes, I would like to take part, my best contact number/email is:_____

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