2/8/2021

Factors Influencing Perceptions and Willingness To Adopt Reclaimed Water Use Amongst Building facilities managers

Masters Research Report

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Abstract

The main aim of the study was to identify the factors that may influence the perceptions and willingness to adopt reclaimed water use amongst building facilities managers in the South African context. This study analysed the Q-sort results from 43 building facilities managers aiming to identify the factors that may influence the perceptions and willingness to adopt reclaimed water use. The survey results assessing the awareness and knowledge of the participants on reclaimed water was also analaysed. The results showed that: (1) the participants in Factor 1 held a more positive perception regarding reclaimed water and they were influenced by cost, knowledge, technology, to name a few; (2) the participants in Factor 2 held a more negative perception as a result of disgust, health concern, technology, to name a few; (3) the participants in Factor 3 seemed to hold similar perceptions to the participants in Factor 1; (4) simarly, the participants in Factor 4 held a positive perception toward the use of reclaimed water in their building facilities. This study could contribute to water policy makers in South Africa, providing information on factors that may hinder the introduction of reclaimed water not only in building facilities but in other South African industries as well.

Chapter 1

Factors Influencing Perceptions and Willingness to Adopt Reclaimed Water Use amongst Building Facilities Managers

Introduction

South Africa currently faces water scarcity challenges due to the recurrence of drought, increasing water demands from different sectors and decreasing of surface water resources (Matchaya, Nhamo, Nhlengethwa & Nhemachena, 2019). The sustainability of commercial buildings in South Africa faces a growing threat due to resources, like water, being constrained (Matchaya et al, 2019). With a constrained water supply, commercial buildings still have high water consumption which results in high water costs and high consumption of a constrained resource. In 2010, commercial and institutional buildings were estimated to contribute approximately 12% to South Africa's high-water consumption for the 2009/2010 period (Matchaya et al, 2019). To reduce water consumption and costs, building facilities managers often institute measures including the use of recycled water as was done by some hotels in Cape Town during the 2018 water crisis. However, while much is known about what influences the general public with respect to decisions about the use of reclaimed water, little is known about the decision-making processes followed by facilities managers. According to Thoo and Marjanovic-Halburd (2015), facilities managers are defined as a “non-core middle management function, acting mainly at an operational level, managing facility resources and services to support the day-to-day operations of an organization, its customers and staff” (Thoo & Marjanovic-Halburd, 2014, p. 3). They are perceived as being part of the support tasks that are important to the goals of the organisation (Alexander, 1996; Kincaid, 1996; Then, 1999; Nutt, 2000). This research report begins by providing an overview of water scarcity and South Africa’s water consumption in three of its largest sectors including commercial buildings. This will be followed by a discussion on alternative water sources normally used in commercial buildings. Factors previously identified as having an influence on an individual's perception and willingness to adopt reclaimed water use will also be discussed. Using the socio-ecological model, this research will highlight how factors from different levels can influence building facilities managers. A summary of the methods, procedures, and data analysis techniques will also be provided. Lastly, this research concludes with the discussion of the results and provides the practical implications of the study as well as recommendations for future studies.

Chapter 2

Literature Review

2.1 Introduction

Water is a natural resource which is an important part of our ecosystem and it is an economic and social good, whose quality and quantity determines the way it is utilised (Mukheibir & Sparks, 2003). Presently, there has been global concerns about potential water scarcity in the face of climate change, population growth, and the related water demands (Cosgrove & Loucks, 2014). Water has become a limiting resource for South Africa's development and as the water supply in South Africa changes, major implications are going to be felt in most of its economic sectors (Cosgrove & Loucks, 2014). Globally, the percentage increase in water use exceeds by twice that of the population growth in recent decades. More and larger regions globally are being subjected to water stress where the rates of water consumption and use have become unsustainable (Cosgrove & Loucks, 2014). As a result of the water crisis being experienced globally, several alternative water sources have been introduced in order to reduce water scarcity and meet the water demands and supply. Regardless of the water crisis, perceptions toward some of these alternative water sources, especially reclaimed water, have been negative in terms of using it for personal use (Mukheibir & Sparks, 2003). This might be a result of several factors that have been identified by studies on public perceptions and acceptance of alternative water sources. Therefore, this literature review will be looking at water scarcity in South Africa and it will also identify different alternative water sources used to supply water to meet organisational water needs. Several studies that have looked to identify factors that influence people's perceptions and acceptance of reclaimed water will be discussed in the literature review to follow.

2.2 Water Crisis in South Africa.

According to Mukheibir and Sparks (2003), South Africa's average annual rainfall is about 500mm, which is about 60% of the world's average. Approximately 21% of the country receives less than 200mm per year of rainfall due to the country's rainfall being seasonal and inter-annual. As a result, stream flow is generally at a low level for most of the year leading to the proportion of stream flow that can be relied upon for use being limited and the country's freshwater resources being constrained, resulting in water scarcity issues (Mukheibir & Sparks, 2003). The Global Water Forum defines water scarcity as the lack of fresh water sources to meet the needs and demands of users of water within communities. It is also a result of physical scarcity of water due to changing climate conditions or drought as well as the demand of water being high and being unable to meet infrastructure capacity (Water for africa, 2009). In a recent study conducted by the CSIR and the WWF, it was found that South Africa had 22 critical water sources which supply freshwater to the country, with just about 77% of water usage being from surface water, 14% from reuse of return flow, and 9% being from ground water (Flanders Investment & Trade, 2018). These water sources deliver about 20% of the country's freshwater supply. South Africa has about 12 Water Boards which provide potable water to approximately 28 million people, supplying potable water to half of the country's population (Flanders Investment & Trade, 2018). One of the provinces that receives its water supply from these Water Boards is the Western Cape, which receives its supply from the Theewaterskloof dam which caters for about 50% of Cape Town's water needs. Other provinces receive their water supply from water imported from Lesotho, which supplies 8 out of 9 of South Africa's provinces (Flanders Investment & Trade, 2018).

South Africa's seasonal rainfall, together with frequent droughts amplified by high evaporation and runoff rates, has resulted in some parts of the country being prone to recurrent droughts, as seen in the Southern Cape region which experienced a severe drought between 2009 to 2011, whilst the rest of the country received rainfall (Flanders Investment & Trade, 2018). Other contributing factors to South Africa's water crisis include the growing population, water pollution, and the way water infrastructures have been managed, with the majority of the infrastructure not receiving sufficient maintenance (Flanders Investment & Trade, 2018). As a result of these factors, Western Cape dam levels were recorded at their lowest level ever in 2017 which resulted in the Western Cape being labelled a disaster area around May 2017 (Flanders Investment & Trade, 2018). In 2018, Theewaterskloof dam levels were at a low of 28% because of the growing patterns of dryness. This resulted in Cape Town City stating that by March 2018 the water supply of municipal water would run out thus placing the city in crisis mode. This was labelled as 'Day Zero' (Flanders Investment & Trade, 2018). Due to the severe drought, the dam levels further dropped to 10% which resulted in most of Western Cape's residents panicking. This led to the City of Cape Town putting water restrictions in place, which meant that residents were not allowed to use more than

50 litres per person of water a day (Flanders Investment & Trade, 2018). South Africa's hydrological resources are expected to be altered because of climate change which will result in added pressure in terms of being able to adapt to future water resources (Schulze & Perks, 2000). If the usage of water continues to grow, it is most likely that the demand will exceed the water supply, leading to some communities being unable to have access to fresh water supply and leading to some communities experiencing water cuts. The government will have to build infrastructures focused on recycling water in order to make sure that water demands are met. This will lead to an increase in the production of clean water which will result in consumers being charged more for water. This will have negative effects for some communities in South Africa as some people will not be able to afford to buy water, which will result in them not having access to fresh water (Price, 2010). If drought is to become more frequent in South Africa, the impact on water sources would be significant resulting in water shortages becoming acute and resulting in an introduction of extreme measures which may include water rationing (Price, 2010). As a result of water scarcity issues, fresh water supply has become one of the main sustainability challenges of the 21st century, which has a negative impact on businesses. In a study conducted by the WWF, it was highlighted that in the coming years, one of the highest societal impacts would be from a water crisis (Schulze & Perks, 2000).

2.3 Water Consumption in Office Buildings

Water and energy are the two major contributors to a building's life cycle supporting the human activities within the building. According to the United Nations Environment Program, buildings often use about 30% of of available fresh water on a global average and generate approximately 30% of the world's effluents (Bardhan, 2011). An analysis conducted in 2011 by the EIRIS found that approximately 54% of companies are often exposed to water issues at some level, and about 9.7% have started to monitor their water consumption levels and have set goals aimed at reducing water consumption. A study conducted by USEPA (2009) highlighted that commercial sectors in the US were consuming about 17% of the total volume of water that was distributed, which made them second only to domestic users. (USEPA, 2009).

According to Donnenfeld et al. (2018), South Africans consume approximately 235 litres per capita per day of water which is above the global average of water consumption of about 175 litres per capita per day. This high-water consumption is also a result of office buildings, which account for an average of more than 4542 litres of water per building per day (Donnenfeld et al, 2018). This figure can increase because of a single leaking toilet which can add about 757 litres per day. Several leaking toilets could double the daily average of water consumed by office buildings (GIIRS, 2014). Chen (2012) found that the annual kilo-litres of consumed water in most of South Africa's office buildings located in its four major cities, namely, Johannesburg, Pretoria, Cape Town and Durban is approximately 2.6 million km^3 (Chen, 2012). Johannesburg's consumption is the highest at approximately 1 million km^3 per annum contributing to the high level of water consumption in office buildings (Chen, 2012). The second largest water consumer was Pretoria, contributing approximately 548 717 km^3 per annum, followed by Cape Town which contributed approximately 497 713 km^3 per annum and lastly, Durban which contributed approximately 291 665 km^3 per annum (Chen, 2012). The study also found that the rest of Gauteng contributed approximately 167 105 km^3 per annum whilst other provinces contributed only 52 198 km^3 per annum to the high level of water consumption in office buildings (Chen, 2012).

The patterns of water use (seasonality and volume), the type of water used, and the quantity of water used within the commercial sector differs depending on the commercial users' nature of operations. For example, a commercial hotel or shopping mall will have different water applications compared to a commercial office park (Morton, 2011). Typical water uses within the commercial sector often include water used for indoor cleaning of floors, the insides of buildings, and the like as well as flushing toilets, washing hands, and for drinking. The water consumption of commercial buildings varies significantly because of various uses of water within the buildings (Morton, 2011). Very often commercial buildings use water for multiple activities which include cooling and heating, domestic (toilet flushing), landscaping, kitchen, and other activities. Several studies have shown that cooling towers, toilet flushing, and landscaping irrigation are three office activities that contribute to the large water consumption of commercial buildings (Morton, 2011). Cooling towers in particular are the largest contributors of water consumption, contributing approximately 40%. They often rely on water evaporation in order to cool air thus consuming 11.4 litres of water per minute for every kilogram of cooling produced (Morton, 2011). This results in approximately 35 litres of water being used for cooling/heating whilst domestic use (toilet flushing) uses about 32 litres, and landscaping on the other hand uses 12.3 litres per minute (Morton, 2011). The kitchen often consumes about 6.1 litres per minute whilst other office activities consume 0.9 litres per minute. In addition, appliances such as washing machines, steam irons, and dishwashers can often consume significant amounts of water. Furthermore, water can be used for general uses outside the buildings and for site utilities, for example, washing cars, cleaning parking lots, steam generation, and hot water production. As a result of all these activities, commercial buildings can often consume and pay for large volumes of water (Morton, 2011).

2.4 Alternative Water Resources

As mentioned above, commercial buildings often use more water than they actually need which results in high levels of water consumption contributing to their high annual water costs. The majority of commercial buildings use three major types of water sources which include potable water, which is fit for human consumption, grey water, which is normally used for irrigation, and lastly rainwater (Morton, 2011). The use of alternative water sources helps to provide adequate water supply for end-users of non-potable water, agriculture, and other industries and also supplements the drinking water supply that allows for water to be safely drinkable.

2.4.1 Potable water

Potable water is the main source of water for the commercial sector in South Africa (Water for Africa, 2009). It is described as water that is treated to drinking quality and is often supplied by water service providers (Water for Africa, 2009). According to Rajagopal, Wichman and Brands (2017), potable water is water that is safe enough for human consumption with minimal risk to human health, whether short- or long-term risk. The two major sources for potable water are surface water and groundwater. Surface water refers to water in rivers and lakes with surface runoff from snowmelt and rain, whilst groundwater refers to water found below the ground with snowmelt and rain percolation and infiltration (Rajagopal et al, 2017).

Potable water is normally treated through sedimentation and flocculation, disinfection, and filtration, which ensures that the water meets health-related quality standards in terms of chemical, bacterial, and physical parameters, making it acceptable for human consumption (Rajagopal et al, 2017). Potable water can be used for activities such as toilet flushing provided that the requirements for quality in terms of visual appearance, odour, micro stability, and suspended solids are met. In South Africa, standards for portable water have not been placed, hence individual users are the ones that determine the requirements for the water. Within the commercial sector, potable water is often used, but it is also possible to use recycled water, harvested water, or raw water for this purpose (Water for Africa, 2009). According to UNEPDHI (2016), the term recycled water refers to wastewater that has been collected from industries, agriculture, and municipalities. It is then treated and purified up to a standard that is safe enough for industrial or irrigation purposes and domestic purposes if treated up to a quality standard (UNEPDHI, 2016). Harvested water on the other hand refers to collected water which is a product of planned or intended action. It can be collected through artificial harvesting processes and stormwater processes, whereby, artificial harvesting refers to the collection of water by humans using artificial ways and not only being dependent on natural processes (Yuen, Anda, Mathew, & Ho, 2001). Stormwater harvesting on the other hand refers to a traditional method of collecting rainwater through drains which is transported to tanks (Yuen et al., 2001). Lastly, raw water is defined as water coming from rain, lakes, rivers, infiltration wells, and ground water and it contains harmful substances or micro-organisms such as ions, minerals, parasites, or bacteria which make the water unsafe for human consumption (The Water Research Commission, 2006).

2.4.2 Grey water

Grey water refers to wastewater that is reused and it is often used for functions that do not need drinking water quality. It is extracted from hand basins, bathtubs, kitchen sinks, and washing machines (Brain, Lynch & Kopp, 2015). It also refers to commercial building/household water that has not made any contact with sewage water/black water. Grey water is often not fit for human consumption. Instead it is used for irrigation, particularly of shrubs and trees whose stems can act as additional filters for contaminants that may be present. Basic grey water systems such as grey water irrigation is often used for diverting shower, hand basin, and bath water into tanks. From these tanks, the grey water is pumped directly onto the garden using an installed pipe network. When grey water is stored for a lengthy period, it can result in the growth of harmful bacteria and pathogens. It is also used for toilet flushing (Brain et al, 2015). Grey water treatment often involves collecting freshwater by directing it to the primary root zone of perennial plants which then helps landscapes to grow productively and beautifully whilst at the same time helping to achieve wastewater treatment without using chemicals or energy (Brain et al, 2015). The microorganisms and plants in the soil consume and filtrate the bacteria and organic nutrients found in grey water, treating it naturally and returning clean water to the water cycle (Brain et al, 2015). More advanced systems such as biological cleaning, sediment disposal, UV disinfecting facilities, and filtration can all be used to treat grey water. (Price, 2010). Grey water recycling can be used for a number of applications, ranging from domestic units up to larger commercial units that have the capability to recycle up to 10 000 litres of water per day. (Price, 2010). The treated grey water can then be used for irrigation of gardens, flushing of toilets, and washing of clothes. The basic grey water gardening systems removes the need for tap water to be used for gardening, which helps reduce water consumption by approximately 30% (Price, 2010).

2.4.3 Rainwater Harvesting Collecting/Management

According to Hardy, Cubillo, Han, and Li (2015), rainwater water is considered as being one of the more promising alternative water sources due to the low treatment needs, added benefits of peak flow reduction and runoff, as well as low environmental impact. Traditionally, semi-arid and arid areas throughout the world have been practicing rainwater harvesting for over 4000 years, which has provided domestic water, drinking water, and water for small irrigation and livestock (Khoury-Nolde, 2000). Rainwater harvesting has since gained significance as a simple, modern, and water-saving technology. It has been applied in countries like South Africa, Algeria, and some parts of North Africa (Hardy et al, 2015) amongst many other countries in the World. It provides more than one purpose, serving as a flood mitigation, supplying water to communities, and serving as a supplement water supply for existing alternative water sources. According to Khoury-Nolde (2000), rainwater harvesting can be classified into two categories, namely, roof-based, and land-based. Roof-based rainwater harvesting refers to the collection of rainwater runoff from rooftop surfaces, which normally provides a cleaner water source that is suitable for drinking after minimal treatment. It is mostly a popular option for households, as it is mainly used for domestic purposes. The water source is close to people, which requires minimum energy for its collection and distribution. Another added advantage is that people can own, control, and maintain the system without requiring the help of other community members. Land-based rainwater harvesting on the other hand, refers to the collection of rainwater runoff from land surfaces such as tanks, reservoirs, dikes, and ponds (Khoury-Nolde, 2000).

Rainwater collected from roof-tops storage tanks may not always be of quality due to poor designs of some storage tanks. The rainwater can contain suspended solids, contain insects, roof catchment such as leaves, and bird droppings creating difficulty for human consumption (Flanders Investment

& Trade, 2018). Several studies have shown that rainwater can be of good quality for drinking water supply without having to apply any other form of treatment as long as storage tanks and catchment are properly managed. (Khoury-Nolde, 2000). Rainwater harvesting is beneficial in that it can save high-quality drinking water sources and relieve pressure on the sewer systems as well as the environment by replenishing groundwater levels and mitigating soil erosions and floods. In addition, rainwater harvesting contributes to the reduction of potable water consumption, and also the amount of generated wastewater (Khoury-Nolde, 2000). Unfortunately, rainwater harvesting is not considered as being a reliable water source due to South Africa being a dry country as a result of experiencing seasonal rainfall that may be unreliable (Flanders Investment & Trade, 2018).

2.4.4 Reclaimed Water

According to Lewis (2011), reclaimed water is water that has been secondarily treated and reused after it flows out of a wastewater treatment facility. Municipal sewer systems carry out large amounts of water used for domestic purposes to a wastewater treatment facility, and after being disinfected and treated, the wastewater is called reclaimed water. It is often treated in accordance with departmental and district rules for beneficial purposes such as agricultural irrigation, landscape irrigation, groundwater recharging, fire protection, industrial uses, and other useful purposes (Lewis, 2011). The process of reclaimed water treatment is a process of collecting, treating, and using wastewater from industries, agriculture, and municipalities. If treated up to quality standard, it can be cleaner than conventional water and it can be used for domestic, industry, and irrigation purposes, and can even be indirectly used for drinking purposes (Roux, 2013). According to Flanders Investment and Trade (2018), reclaimed water is perceived as being a more reliable water supply source than groundwater and surface water in some parts of South Africa and it is also considered as contributing positively to the conservation of freshwater. It is not only less sensitive to increased demand, but it is also less sensitive to drought. Reclaimed water goes through basic or advanced treatment before being discharged into a groundwater or surface water reservoir (Roux, 2013). One commonly used process is indirect potable reuse, which is the purification of reclaimed sewage water, purifying it to drinking standards before being released back into communities. This process is commonly used globally (Roux, 2013). Treatment processes such as sufficient operating capacity, advanced technologies, and proper monitoring are considered as being important for reclaimed water, as they ensure that the treated wastewater is of appropriate quality (Roux, 2013).

According to Water Global Practice (2018), reclaimed water has made non-potable wastewater useful, thus saving the environmental and economic costs relating to the development of new water supplies. Reclaimed water can be considered as an important adaptation response to climate change. It can provide water supply during unpredictable weather patterns and mitigate their effects, such as sea level rise and droughts, which can have negative consequences on the freshwater resource quality and quantity water supply (Water Global Practice, 2018). Reclaimed water has been used as a water source for non-portable purposes for many years in South Africa. It has mostly been used for cooling boilers, irrigation, dust suppression, etc. Due to the lack of regular rainfall and technological development, reclaimed water treated to quality drinking water standards has slowly started to become a reality. In South Africa, the use of reclaimed water for potable and non-potable purposes has been considered as a result of many issues such as the constant depletion of ground and surface water sources, drought (e.g Beaufort West and George), population growth, increasing demand (e.g. eThekwini), coupled with the high cost of treating sea water (e.g. Overstrand municipality). As a result of these issues, several other municipalities have been considering reclaimed water as an option to augment their water supply in order to meet the rising water demands. This has resulted in the construction and commission of the first water reclamation plant established in Beaufort West for direct portable water in South Africa and it is the second one in the Southern Africa Region (Muanda et al., 2017).

Reclaimed water has widely been used internationally as a substitution for fresh water in certain applications and has been used in a limited capacity in South Africa. Internationally, reclaimed water has been used for construction applications, industrial, agriculture/irrigation, potable water, return to rivers and groundwater recharge. Countries like Japan, use reclaimed water for train washing, toilet flushing, agriculture, enviromental purposes, landscape irrigation, and industrial purposes (Grobicki & Cohen, 1998). Reclaimed water in South Africa has been used for cooling in municipal stations, irrigation in urban areas, aquifer storage, and recharging of industrial water. The potential for reclaimed water in South Africa is great, yet it is not used as much as expected, but would be beneficial as it would address some of the water demands currently experienced (Grobicki & Cohen, 1998).

2.4.4.1 The history of reclaimed water

Water reclamation processes have been around for millennia. The first recorded wastewater system was built by the Minoan civilisation in 3000 BC, in Greece. They used wastewater for their crops, and since then wastewater systems have improved with the development of sewage systems, water piping systems in homes, and flushing toilets which occurred in the mid-19th century (Angelakis, Asano, Bahri, Jimenez, & Tchobanoglous, 2018). In the bronze age (ca. 3200-1100 BC), wastewater was used for aquaculture and irrigation by several civilizations including those that developed in the Orient, China, Egypt, Mesopotamia, Crete, and the Indus Valley. In historical times (ca. 1000-3300 AD), the Roman and Greek civilizations used wastewater for fertilization or irrigation purposes. As humankind matured, knowledge on wastewater reuse and treatment accumulated (Angelakis et al., 2018). In more recent times, reclaimed water projects are being implemented globally for several potable and non-potable applications. In the past, wastewater was collected, processed, and disposed of so as to not harm the water environment. This has radically changed over the years as wastewater collection systems and treatment processes have evolved, which has resulted in wastewater being considered as a resourceful asset that needs to be further explored (Angelakis et al., 2018). Reclaimed water has, over the years, gained popularity because of a number of factors such as climate change, urbanisation, population growth, the growth of megacities, and the increasing need for water for various applications. The development of water reclamation technologies has resulted in the production of quality water that is higher or equal to drinking water (Angelakis et al., 2018). As a result, reclaimed water has become a more reliable, additional, and alternative water source for several countries around the world. Countries like Singapore, Australia, Namibia, the United States, states in the Middle East, and most recently South Africa have had a significant development in water reclamation, which can be treated to quality and safe standards, resulting in the reduction in water supply shortages (Cotruvo, 2016). The Namibian water reclamation plant was initiated in 1968 when the city of Windhoek reached its limits of conventional drinking water sources during the 1960s. The city's groundwater and surface water had already been exploited (Cotruvo, 2016). In South Africa, Durban was faced with a sewage capacity restraint. As a result, the Durban municipality managed to successfully implement a water reclamation project for industrial purposes (Water Global Practice, 2018). This is an example of a successful sustainable wastewater management project with multiple social, economic, and environmental benefits. In addition to this, this project is a first of its kind in South Africa and has become a good exemplar of a solution that shows that wastewater can be an assert rather than a liability that needs to be disposed (Water Global Practice, 2018). It also shows that reclaimed water can be successfully used to supplement potable water, making it a viable solution for water shortages. Regardless of this, the use of reclaimed water for potable uses has been least popular. Literature has shown that this is a result of social issues that relate to the adoption of reclaimed water by communities. In the United Kingdom, most people had a preference of using their own recycled wastewater rather than using wastewater from a common public source. In Orange County (USA), people felt that regardless of wastewater being recycled, it was still wastewater. Although it has been shown that reclaimed water has advantages, several examples, internationally, show that people are still resistant to the idea of using reclaimed water for portable uses (Water Global Practice, 2018).

2.4.4.2 Benefits and challenges of using reclaimed water

Reclaimed water has slowly grown to be popular throughout the world as a reliable water resource and it has been shown to have several benefits (Exall, 2004). According to Exall (2004), reclaimed water can be beneficial for the environment, instead of wastewater being discharged into the environment, it can be retained and treated up to quality standards, reducing the possibility of potentially polluting the ecosystem. Treated reclaimed water can be pumped into a river or stream in order to compensate for upstream water extractions and to augment for multiple in-stream flow requirements, freeing up limited potable water resources, resulting in the reduction of effluent discharge into receiving waters. It has been shown to conserve the energy required for the extraction and transportation of freshwater to communities. Reclaimed water can also be used to restore or enhance wetland habitats. The use of reclaimed water can also lead to significant improvements in the water quality of downstream rivers (Exall, 2004). The use of reclaimed water is not only beneficial for the environment, but it is also beneficial for its socioeconomic effects, in terms of increasing water availability for arid or water stressed areas. It is a water source that is easily accessible to economic sectors such as agriculture and industry, promoting food production and economic development. Reclaimed water improves the quality of agriculture because of the nutrients extracted from the wastewater. It also increases climate resilience as well as reducing technology costs, compared to the alternatives such as water transportation and extraction. The use of reclaimed water in the place of freshwater helps to free up the capacity on the existing freshwater supply system, resulting in the reduction of costs on water transfers, development of new water sources, as well as costs on treatment and distribution systems (Exall, 2004).

Literature has highlighted the challenges and costs of reclaimed water, which can hinder the successful introduction in communities. However, it has been shown that reclaimed water can contribute to health risks if the wastewater has not been treated adequately resulting in people being exposed, for example by consuming raw vegetables that have been irrigated with contaminated reclaimed water (Esposito, Tsuchihashi, Anderson, & Selstrom, 2005). If there is failure to do a thorough risk assessment during the initial phases of treating reclaimed water, the water could contain unknown contaminants which could pose health risks (Esposito et al., 2005). Another barrier to the successful introduction of reclaimed water is public acceptance (Esposito et al., 2005). This is due to the public being concerned with both the environmental effects of pollutants in the water and water supply. Due to the increasing concerns of contaminants, the public has become hesitant to use non-potable water, even if it has been proven to be safe (Esposito et al., 2005).

Whilst reclaimed water is considered as being a reliable water supply source, transitioning from one supply to the new reclaimed water supply raises cost concerns (Van Niekerk & Schneider, 2013). The operating and capital costs that are associated with implementing reclaimed water treatment systems and the potential new distribution networks raise major investment concerns (Van Niekerk & Schneider, 2013). All these barriers need to be understood, worked through, and resolved in order to ensure that the appropriate reclaimed water treatment systems are implemented (Van Niekerk & Schneider, 2013). There have been examples whereby the implementation of reclaimed water treatment systems has been unsuccessful which has been due to a number of reasons such as technical elements not being resolved, and the measures and risks to safeguard against risks being poorly communicated hence leading to a delay in implementation or no implementation at all (Van Niekerk & Schneider, 2013). Regardless of the above mentioned issues, there are a number of examples of successful implementation of reclaimed water treatment that are supporting industry and agriculture sectors and are also supplying water to people in major cities around the world (Van Niekerk & Schneider, 2013). Unfortunately, the use of reclaimed water for direct-reuse is considered as posing a health risk to the safety and health of the public if it is not treated properly and therefore needs water quality control and management (Van Niekerk & Schneider, 2013). Community acceptance and public perceptions of reclaimed water therefore contribute to the challenge of introducing reclaimed water for direct use (Van Niekerk & Schneider, 2013).

2.5 Factors influencing perceptions and willingness to adopt reclaimed water use

The reuse of reclaimed water, whether indirectly or directly, can result in a number of public concerns which may be a result of a number of factors influencing people's perceptions and willingness to adopt reclaimed water use. In order to successfully implement reclaimed water, risks and perceptions related to trust in water providers, and public acceptance need to be addressed (Van Niekerk & Schneider, 2013). Studies conducted by Tricoche (2014), Fielding, Dolnicar and Schultz (2017), Massoud et al. (2018), and Zhu et al. (2019) have all identified factors that may influence people's perceptions and acceptance of reclaimed water. Prevalent factors that were identified by these studies include knowledge and information, religious and cultural beliefs, the "yuck-factor", trust (in public policy makers or water providers), perceptions of risk, and past experiences with alternative water sources. For example, in a study conducted by Dolnicar, Hurlimann and Grun (2010), which aimed to identify factors that may lead to high levels of public acceptance of desalinated and recycled water, factors such as risk perceptions (negative), trust in the authorities, information/knowledge, health concerns (negative), past experience with reclaimed water, and also perceptions of good water quality were found to play a role in influencing community acceptance of reclaimed sewage water and desalinated water. Demographic factors such as gender (being male), age (older and younger), and education level (higher education degree) were also identified as drivers of public acceptance of desalinated water and recycled water. Positive perceptions about alternative water sources and the extent to which other people influenced an individual's decisions about reclaimed water were identified as key drivers of public acceptance (Dolnicar et al, 2010).

A study by Massoud, Kazarian, Alameddine and Al-Hindi (2018) found that people were more willing to use reclaimed water for purposes that had minimal physical contact, such as agriculture and landscaping. People were more hesitant to use reclaimed water for personal use like washing hands or for drinking. The study also found that a number of people lacked trust in the governing institutions and authorities in charge of the water supply. This explains people's perceived health concerns and risk perceptions. Public acceptance was found to also be influenced by the "disgust factor", which meant that people regarded recycled water as being disgusting and were not willing to use the water. In another study conducted by Marks, Martin and Zadoroznyi (2006), which aimed to look at people's acceptance of introducing water reclamation as a water conservation strategy in an Australian community, it was found that people were willing to use reclaimed water for purposes such as car washing and watering their gardens, but they were less prepared to use water for anything related to personal use. This study identified that rainwater was a preferred water supply for drinking water and desalinated water was more preferred than storm water for household use (Marks et al, 2006).

The use of reclaimed water remains uncommon due to people being disgusted by the idea of using water coming from the toilet going into taps. In a study conducted by Alhumoud and Madzikanda (2010) looking at people's attitudes toward drinking reclaimed water, it was shown that 77.91% of respondents were not in favour of using reclaimed water for drinking whilst 5.26% of respondents had no problem with using reclaimed water for potable purposes. Most respondents preferred that reclaimed water be used for activities such as laundry (20.9%), car washing (66.8%), agriculture (75.3%), cooking (8.33%), showering (15.2%), and house cleaning (55.6%). These findings indicate people's resistance and disgust toward using reclaimed water for potable purposes. People were mainly resistant because of a general willingness to use reclaimed water, or because of psychological resistance, mistrust of municipal water workers, mistrust of the technology used, and the concerns they have toward the water quality, as well as health concerns. (Alhumoud & Madzikanda, 2010). This shows that the issue is the perception that people hold towards reclaimed water, which is very often expressed as repugnance or the "yuck" factor. Regardless of the 'science' and the technical know-how around reclaimed water, there is still public mistrust perpetuated by gaps between expert knowledge and the layperson. Other factors such as a lack of understanding of water reclamation (i.e. the treatment process and purposes), and unwillingness to pay, also contribute to the public being resistant toward reclaimed water (Muanda et al., 2017). All these studies highlighted several factors that may influence the perceptions and willingness to adopt reclaimed water use in the public domain.

2.6 Bulding Facilities Managers

According to Potkany, Vetrakova and Babiakova (2015), facilities managers provide support to their buildings, providing long term planning for their building and focus on their occupants. They help to assist business management by providing services that are cost-effective and relevant which helps support the building's main activities (Potkany, Vetrakova, & Babiakova,2015). Building facilities managers are perceived as providing optimisation and savings of their buildings' operating costs, and they aim to increase employee performance which contributes to their buildings' profit being enhanced. According to Finch and Zhang (2013), facilities managers ensure the maintenance and development of their building facilities which ensures the effectiveness of the buildings' primary activities. IFMA (2020), highlighted that the profession of facility management is made up of multiple disciplines which help to ensure comfort, functionality, efficiency, and safety of the built environment. Facilities managers are perceived as having more than one professional job title and they can reach the facility management profession through a variety of career paths. They ensure that the systems in their buildings work effectively and efficiently. Facilities managers help to ensure that their building facilities are safe, productive, sustainable, and comfortable to work or live in (IFMA, 2020). Furthermore, they are responsible for making choices about how they can supplement their water sources, whether through the introduction of water technology aimed at ensuring sustainable water supply or investing in reclaimed water for their building facilities.

2.7 Socio-ecological model

For this study, Bronfenbrenner's socio-ecological model was used as a theoretical framework to further elaborate on how the above-mentioned factors influence an individual's willingness to adopt and use reclaimed water. The socio-ecological model was first suggested by Bronfenbrenner as a conceptual model, which later became formalised as a theory. The theory can be used to explain how different types of environmental systems influence human development (Velez-Agosto, Soto-Crespo, Vizcarrando-Oppenheimer, Vega-Molina, & Coll, 2017). According to Kilanowski (2017), Bronfenbrenner initially introduced the model by illustrating nesting circles that placed an individual at the centre surrounded by various systems which differ in their complexity and scope. The nest circle is made up of five concentric systems, namely the microsystem, the mesosystem, the exosystem, the macrosystem, and the chronosystem

(Kilanowski, 2017). Vest Ettekal and Mahoney (2017) state that the five environmental systems are interrelated, and they range from smaller, proximal settings, in which people interact directly with larger, to distal settings which may indirectly influence their development. The microsystem is the most proximal level which is at the base of the circle closest to the individual and it encompasses the relationships and direct interactions of an individual's immediate surroundings and it also contains the strongest influences. (Vest Ettekal & Mahoney, 2017).This system is made up of attitudes, skills, knowledge, and beliefs and it is also made up of an individual's family, peers, school, church, and health services. (Vest Ettekal & Mahoney, 2017).The second system is the mesosystem, which has to do with processes that happen between the multiple microsystems which an individual is in. (Vest Ettekal & Mahoney, 2017).Thus, what occurs in one microsystem has an impact on what occurs in another microsystem. Furthermore, many of the microsystems interact with several activities which contribute to an individual's development (Vest Ettekal & Mahoney, 2017).

The third ecological system is the exosystem, where the individual is not directly influenced by this level but instead the system exerts both positive and negative interaction forces which include social networks and community contexts (Lee, Benxsen, Liebman & Galleghe, 2017). This system is more of an organisational or institutional level which encompasses policies and rules that can provide guidance and support to the individual's behaviour. This can aggregate an individual's interpersonal relations in spaces such as social organisations, schools, and the workplace. The fourth system making up the nested circles is the macrosystem. This system is made up of religious, cultural, and societal influences and values. This system is more of a community level which is made up of collective networks such as institutional, organisational, businesses, or communities of individuals (Lee et al, 2017). Advocacy and media constructs can also be included in these large social constructs and they can be defined by membership, affiliation, heritage, or geography. The last system is the chronosystem which encompasses both the external and internal elements of historical and time contents (Lee et al, 2017).

According to Velez-Agosto et al. (2017), Bronfenbrenner developed the process-person-context-time (PPCT) model. This model was considered as being the appropriate research design which can be used to investigate hypotheses coming from bio-ecological theory. This model considered human development to be impacted by four joint properties, namely the person, context, process, and time. According toVelez-Agosto et al. (2017), proximal processes are the main construct of the PPCT model, and they are considered to be reciprocal interactions that happen between an individual who is developing and one or more of the objects, symbols, and persons in their immediate environment. As time progresses, the reciprocal interactions become more complex. Therefore, as the proximal processes become more complex, they are more likely to be helpful to developing individuals. Individuals are able to gain skills, abilities or knowledge, helping them to become more competent. Thus, proximal processes are considered as being primary engineers to human development (Velez-Agosto, 2017).

According to Bronfenbrenner's revised theory, the person factor refers to the individual characteristics of a person, specifically gender, competency, and age, which interacts with an individual's setting, thus influencing their development (Vest Ettekal & Mahoney, 2017). For example, an individual's age may influence their perceptions of using reclaimed water within their building facilities (Vest Ettekal & Mahoney, 2017). The context factor is made up of the four environmental systems described by Bronfenbrenner's original theory. The process factor is the primary mechanism for human development, and it represents the interaction between the context factors and the person factors. For example, an interaction between an individual's competency as a building facilities manager and the rules or policies within their organisation may influence their perceptions toward reclaimed water use (Vest Ettekal & Mahoney, 2017). The competency an individual has as a manager may be guided by the rules or policies within the organisation, as a result, the manager may not be willing to adopt reclaimed water technology due to the lack of policies toward reclaimed water and due to them always following the rules and policies as guidelines to ensuring their building facilities' needs are met (Vest Ettekal & Mahoney, 2017). Therefore, there is an interaction between an individual's personal characteristics (competency) and the context factors such as policies and rules which form part of the exosystem. In order to understand the dynamic nature of development, it is important that proximal processes are understood with reference to the fourth property which is time (Vest Ettekal & Mahoney, 2017). According to Vest Ettekal and Mahoney (2017), the occurrence of proximal processes often happens in specific places and in a specific time within specific historical contexts. Time is often construed at multiple levels of the environmental systems, namely, micro-time (which refers to specific episodes), meso-time (frequency of those episodes, from days to weeks), macro-time (which is also chronotime) (Vest Ettekal & Mahoney, 2017).

As highlighted by the socio-ecological model, each of the five systems have factors that can have some form of influence on an individual. Factors identified in previous studies mentioned above can fall into any of the five systems. These factors can interact with each other and influence the perceptions and willingness to adopt reclaimed water use amongst building facilities managers. For example, in a study conducted by Dolnicar, Hurlimann and Grun (2010) it was found that knowledge or information (which is part of the microsystem level) together with the influence of others (which forms part of the exosystem level) resulted in the likelihood of people using recycled water being low. This means that having no, or some form of knowledge or information about reclaimed water, together with the greater influence of either employees or a key opinion leader within the organisation can result in the likelihood of using reclaimed water being low. Multiple microsystem factors can interact with each other in the mesosystem influencing an individual. For example, the lack of knowledge and beliefs that an individual has in the mesosystem can influence their willingess to adopt reclaimed water use. Each of these factors on their own can still influence the perceptions and willingness to adopt reclaimed water use amongst building facilities managers (Dolnicar et al, 2010).

The socio-ecological model has mostly been used in health promotion since the 1980s and has also been used for prevention purposes and the introduction of interventions (Kilanowski, 2017). Over the years the framework has been used to understand and guide population-based health behaviour change interventions, identifying factors that may contribute to people behaving the way that they do and using this to develop interventions (Kilanowski, 2017). The socio-ecological model has rarely been used to understand factors that may contribute to certain behaviours within an organisational context. A number of studies conducted using the socio-ecological model within organisational contexts have looked at physical activity and sedentary behaviour. For example, a study conducted by Ammendolia, Cote and Amick III (2016), used the socio-ecological model as a framework for developing a workplace health promotion wellness program. This supports the fact that the socio-ecological model is mostly used as a framework for developing interventions. Thus, it is rather important that the socio-ecological model is not only used for the development of interventions but is also used to identify and understand factors that may contribute to certain behaviours or perceptions within organisations.

2.7 Conclusion

This literature review aimed to highlight the water crisis currently faced by South Africa. This water crisis has resulted in some parts of South Africa facing water scarcity. Regardless of this, commercial buildings in South Africa use more water than they need, resulting in high water costs and inefficient water use. A number of measures are often introduced within organisations in order to reduce water consumption and one of those measures includes the use of reclaimed water to supplement the organisation's water supply. As shown by Bronfenbrenner's socio-economic model and a number of studies mentioned above, a number of factors may influence an individual's willingness to adopt reclaimed water use. Therefore, as highlighted above, it is important for organisations to understand the factors that may influence the perceptions and willingness to adopt reclaimed water use amongst building facilities managers. Thus, this research looked to identify factors that may influence the perceptions and willingness to adopt and use reclaimed water use amongst building facilities managers.

2.8 Research question

What are the factors influencing perceptions and willingness to adopt reclaimed water amongst building facilities managers?

2.9 Rationale

According to Water Research Commission (2019), on a global scale, demand for fresh water is predicted to increase at an annual average rate of 2%, resulting in a demand of approximately 7 trillion km^3 by 2030. The water crisis has become a global issue, with countries, such as Israel, Eritrea, and India using approximately 80% of their available water supply. The uncertainty of water supply because of climate change and a number of other factors has led to a burgeoning water crisis globally (Water Research Commission, 2019). Regardless of South Africa's water crisis, its water consumption is higher than that of other water stressed countries, with three of its sectors, namely agriculture, municipalities, and industrial sectors contributing to the high water consumption (Donnenfeld et al., 2018). Often, measures aimed at augmenting existing water sources can be introduced by managers and one of the measures is the introduction of alternative water sources such as reclaimed water which can be used to supplement the organisation's municipal water supply (Donnenfeld et al., 2018). As mentioned by Levin (2020), some countries have successfully applied reclaimed water use, which has provided several benefits. Regardless of the benefits that reclaimed water has, some managers may not be open to using reclaimed water which may be a result of several factors. This study will also contribute to a better understanding of organisational water consumption behaviours and how a number of factors may hinder the introduction of reclaimed water within organisations. This study may therefore be beneficial for water policy makers and organisations. Therefore, it is important that the various factors that may influence the perceptions and acceptance of reclaimed water by building facilities managers are identified and addressed in the South African context.

Chapter 4

4.1 Methods

This study used data collected using a visual Q-methodology, administered online. According to Leggette and Redwine (2016)., a Q-methodology is neither fully quantitative nor is it fully qualitative, it is more of a bridge between the two methodological approaches. It places an emphasises on the qualitative how and why people think the way they do, but not trying to quantify that into how many people think a certain way (Leggette & Redwine, 2016). Q-methodology allows for the researcher to identify, comprehend, and categorise individual opinions, and perceptions. Researchers are then able to cluster groups of these categorizations (Leggette & Redwine, 2016). According to Stenner and Watts (2012), the Q-methodology aims to reveal perspectives, or several viewpoints, that may be shared on a specific topic of interest. The Q-methodology can either be used online (Visual Q-methodology) or on paper. It is made up of four stages, namely the development of the Q-sort, Identification of the P-set (sample), Q-sorting, and analysis (Q factor analysis) and interpretation (Stenner & Watts, 2012). As shown by a number of studies that have used Q-methodology, a series of perspectives pertaining to the topic of interest are revealed, which made this method suitable for the study. Most studies (Buchel and Frantzeskaki 2015; Fairweather and Keating 1994; Delnero and Montgomoery 2001; Hashim & Meloche, 2007) that have used Q-methodology as a method of data collection have been paper-based and conducted in the Global North and Western contexts, specifically in countries like the US or countries in Europe. These studies have been conducted in disciplines such as agriculture, commerce, ecology, education, as well as political science (Leggette & Redwine, 2016). For example, Hensel and Decker (2015), used a Q-sort comprising 30 statements to examine perceptions of poverty amongst nursing students. Jeffares and Dickinson (2016) used the visual Q-methodology to look at the collaboration between organisations and public service (Leggette & Redwine, 2016). In comparison to the studies conducted in the Global North context, very few studies have been conduted in South Africa that have utilised the Q-methodology as a method of data collection (Finchilescu & Muthal, 2018). Some of the studies conducted in the South African context have mostly been conducted within the medical field (Cramm, Van Exel, Møller and

Finkenflügel 2010; Mckenzie, Braswell, Jelsma and Naidoo 2011; Mckenzie and Swartz 2011). One study conducted outside the medical field was a study conducted by isher, Du Rand and Erasmus (2012), which was conducted in the Marketing discipline, with the Q-set made up of photographs of food as they were trying to get insight into how consumers perceived the food shown in the photographs (Finchilescu & Muthal, 2018).Howver, this is not only the number of studies conduted within South Africa that have used Q-methodology, as a result of the lack of a central database, more studies are difficult to locate which may have been conducted focusing on other fields (Finchilescu & Muthal, 2018).

4.2 Research Design

This study used a descriptive, qualitative-quantitative, non-experimental research design, which was selected due to its high degree in representing the participants' opinions and because of the ease with which the researcher could obtain the participants' opinions (Polit & Beck, 2004). The study also used a cross-sectional research design which was selected because it provided the researcher with the ease of measuring the exposures and outcomes in the participants at the same point in time (Polit & Beck, 2004). According to Lavrakas (2008), a cross sectional research design has to do with collecting data at a single point in time in order to make a deduction about the attitudes, knowledge, and behaviour of participants (Polit & Beck, 2004).

4.3 Measures

For this study, demographic information of the participants specifically their gender, ethnicity, and age were used to provide a description of the sample. Information on knowledge of reclaimed water, number of years they have been working as a building facilities manager, whether they considered themselves to be building facilities managers, the province they are from, and their nationality were also used to describe the sample. For the Q-sorting procedure, forty statements were used and each of the statements represented several factors that the researcher was looking to identify as influencing perceptions and willingness to adopt reclaimed water use amongst building facilities managers.

4.4 Instrument

The first of the four stages of the Q-methodology is the formulation of the Q-sort which can be composed of statements, pictures, descriptions of behaviour, and traits (Stenner & Watts, 2012). For this research, statements were used. These statements were representative of the concourse of the research. The concourse refers to the broader topic of alternative water sources; specifically, reclaimed water and the factors that may influence the perceptions and willingness to adopt reclaimed water use. The study arrived at 40 statements which covered themes such as reclaimed water use, factors that may influence perceptions and willingness to adopt reclaimed water use, knowledge of reclaimed water and other sub-issues within the concourse (Brouwer, Pieron, Sjerps & Etty, 2019). Initially the study had 56 statements, but a total of 16 statements were removed because they were duplicates or because they did not fit the overarching theme. Reducing the number of statements helps to avoid having participant fatigue during data collection. The themes covered by the 40 statements were selected due to being identified by previous studies as being the most prevalent factors that influenced the perceptions and willingness to adopt reclaimed water use amongst the public. These Q-statements were formulated from secondary sources specifically the literature, surveys, editorials, previous studies (Mbeng, Phillips, & Fairweather, 2009; Ching, 2015; Ching, 2016; Ormerod, 2017) which have used Q-methodology on reclaimed water and other studies that have looked at reclaimed water. Once the statements were formulated, they were sent to five experts who helped with refining the Q-statements and checking for duplications and missing statements. The statements were formulated in a table format, with each statement categorised in the themes mentioned in the literature review chapter. Each of the statements were numbered and were also randomly presented to participants. To ensure validity of the statements, the statements were checked by the researcher’s supervisors who both have experience in the formulation of Q-statements. Through the Q-statements, factors that may influence the perceptions and willingness to adopt reclaimed water use amongst building facilities managers were appraised. The attached Q-statements (Appendix A) were developed further to ensure that the statements represented all the relevant themes in the concourse.

4.5 Sample

The second stage is the definition of the P-set (or the sample). The sample size of the study was made up of 43 participants specifically looking at building facilities managers from small and large building facilities, as a result of the different perceptions that these managers may have regarding using reclaimed water for their building facilities (Stenner & Watts, 2012). The majority of studies (Singer, 1997; Leggette et al., 2015) that have utilised the Q-methodology often use a small sample size, and typically their results are not negatively impacted by low response rates that often impact survey results (Leggette & Redwine, 2016). According to Kirshbaum, Barnett, and Cross (2019), participants used in the Q-methodology often range between 40 and 80 participants. There has been little evidence supporting the selection of this number of participants. However, the sample has to be diverse even if it is not large and representative of the whole population, which was achieved by this study. This allowed the researcher to have a diverse range of opinions (Zabala, 2014). Delnero and Montgomery (2001), had a small number of participants, with 23 participants making up their P-set. Fairweather and Keating (1994) had a larger number of participants, with 50 participants making up their P-set. The sample in the Q-methodology studies are more about the variety of statements than a representation of the population. The concourse (the opinions collected about the topic being investigated) of this study is therefore actually a representation of the "population" of the study (Leggette & Redwine, 2016). In approaching building facilities managers, the researcher was granted access through the South African Facilities Managers Association (SAFMA) who sent out an invitation to participate by email to their membership. The sample's demographic information is discussed below.

4.5.1 Profile (description) of the participants

In this section, the profile (description) of the participants, specifically the demographic information of the participants, will be discussed. For this study, Q-sort data were collected using the "QMethodology" software. Demographic information of the participants as well as knowledge on reclaimed and wastewater was gathered by a short demographic survey using the "QMethodology software". Participants were required to fill the information in at the end of the Q-sorting.

4.5.1.1 Demographic information

In analysing the participant's awareness, knowledge, demographic information, SPSS version 25 was utilised. The data was analysed using frequencies, which provided detailed demographic information of the participants and the overall percentage. The analysed data for demographic information included gender, ethnicity, nationality, socioeconomic status (level of schooling, employment status), and province. The researcher looked to analyse the age, ethnicity, gender, nationality, province, and socio-economic status of the participants as shown in Table 1

Table 1 Demographic information

Demographic Information	**Frequency**	**Percent (%)**
Gender		
Male	26	65
Female	13	32.5
Other	1	2.5[1]
Race		
White	20	50
African	7	17.5
Indian	5	12.5
Coloured	6	15
Other	2	5
Age		

[1] The total number of participants for the Q-methodology study added up to 43, however, the survey seemed to have removed responses from three participants. Hence, the number of participants in the Q-methodology and the survey are different.

20-30	1	2.5
30-40	12	30
40-50	18	45
50-60	6	15
60-70	3	7.5
Nationality		
South African	40	100
Province		
Gauteng	25	62 .5
Western Cape	10	25
Eastern Cape	2	5
KwaZulu Natal	2	5
Free State	1	2.5
Level of Schooling		
High School	3	7.5
Degree	16	40
Postgraduate	14	35
Other	7	17.5
Employment Status		
Employed	34	85
Self-employed	6	15

The researcher looked to analyse whether participants perceived themselves as building facilities managers, the number of buildings they managed and the number of years they managed buildings. Table 2 below provides these results.

Table 2

Do you consider yourself to be a building facilities manager?	**Frequency**	**Percentage (%)**
Yes	20	50%
No	20	50%[2]
Number of buildings they managed		
0-10	31	77.5
10-20	3	7.5
20-30	4	10
40-50	1	2.5
50-60	1	2.5
Number of years as a building facilities manager		
0	14	35

[2] 50% of the participants indicated that they did not identify as building facilities managers. They were kept in the study because they met the sample selection criteria of performing duties of building facilities managers who oversee activities within their building facilities but their job titles did not specifically use the term “building facilities manager”.

1	4	10
2	5	12.5
3	1	2.5
5	1	2.5
6	2	5
9	4	10
15	1	2.5
16	1	2.5
20	1	2.5
26	1	2.5
30	3	7.5
50	1	2.5
56	1	2.5

4.6 Sampling Method

For the sampling method, purposive sampling was used. According to Maxwell (1996), purposive sampling, also known as judgemental sampling, is a technique used in which certain events, persons, or settings are deliberately chosen to provide necessary information which cannot be collected from other choices. This method was suitable for sampling South African building facilities managers with different experience levels in managing large and/or small buildings. Their experience in managing buildings made them suitable participants who would be able to provide their opions and viewpoints relating to the study topic. They would provide necessary information which cannot be provided by any other sample. In getting access to the sample, managers were sampled through SAFMA. In addition to getting managers through SAFMA, the researcher's supervisor provided contact details of additional building facilities managers who were also invited to participate.

4.7 Procedure

The third stage of the Q-methodology is Q-sorting, which was used as a procedure for collecting data. According to Denzine (1998), Q-sorting is a method of data collection whereby participants are required to rank statements that represent either their views, values, or beliefs on the issue at hand. This is normally done on a forced distribution also known as a Q-grid (Denzine, 1998). Several Q-methodology software programmes have been developed in order to help researchers overcome the limitations of the traditional paper-based Q-methodology (Nazariadli, Morais, Supak, Baran & Bunds, 2019). A Q-methodology software, specifically Qmethodology software (https://app.qmethodsoftware.com/study/6092), was used to administer the Q-statements online to building facilities managers. Before conducting the Q-sorting, participants were presented with instructions which guided them on how to perform the Q-sort. Participants first read through the statements indicating their agreement, disagreement, or neutrality with each statement.

Next, the statements were presented to participants whereby the statements were separated into three boxes, with each box representing whether they agreed, were neutral, or disagreed with each statement. The participants were able to drag and drop the statements from each of the three boxes into the graded grid (as explained in section 4.7-see Figure 1). In a Q-sort, statements are normally sorted in relation to one another which helps reveal the underlying opinions, beliefs, and values of the participants (Paige & Morin, 2016). Lastly, the participants responded to some general demographic questions.

Figure 1: Forced distribution grid

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5

4.8 Ethical considerations

Before the study was conducted, permission was requested from the Wits ethics committee (non-medical) which was granted (Ethics protocol number- MAORG/20/08). Informed consent was requested from every participant before partaking in the study. This was done after participants read through the participant information sheet. Participants were required to click on the consent button which led them to the study if they had indicated their consent. Participants were also provided with written information about the study and also about their choice of withdrawing from the study at any point up until they had clicked on the final submit button. Confidentiality was ensured through procedures such as the participant's identity remaining anonymous and data being stored in a password protected file. Anonymity was guaranteed as participant's information such as names and ID numbers or any information that may reveal their identity was not collected. Participants did not have any form of contact with the researcher as the Qmethodology software site stored the data on the site for the researcher. Participants were not required to give their names or any other direct identifier. If feedback on the study was requested by participants, the researcher provided a summary to them.

4.9 Data Collection Procedure

The study required the participants to provide opinions on which factors they felt would influence perceptions toward adopting reclaimed water use amongst building facilities managers. Participants were each provided with a link to the study on the Q-methodology software. They were each presented with 40 statements in a card format that each had a thumbs up, thumbs down and question mark icon as shown in figure 2 below.

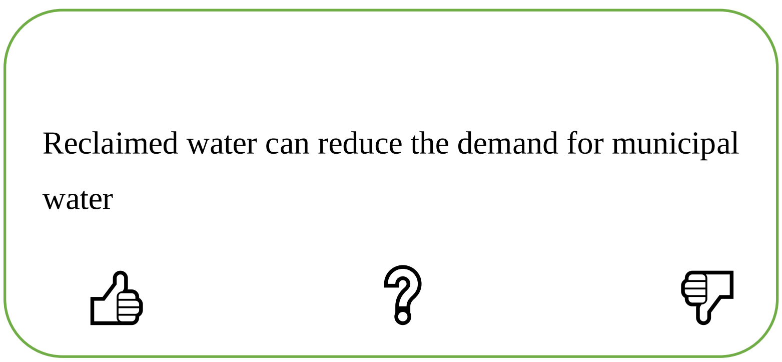


Figure 2: Statement 1 presented to participants

Each participant was required to read through the statements and click on one of the three icons which divided the statements into three categories. The thumbs up icon represented the statements they agreed with, the thumbs down icon represented the statements they disagreed with, and the question mark icon represented the statements they were unsure about. Once participants were done with reading the statements, they were presented with the three divided categories, from which participants were asked to rank the statements onto a forced distribution grid illustrated in Figure 1 above. The grid ranged from -5(strongly disagree) to +5 (strongly agree). Participants were required to place a maximum of two statements they strongly agreed with (+5) or strongly disagreed with (-5). The forced distribution grid presented in Figure 1 was made up of 43 blocks to match the number of statements. Participants were then required to rank all the statements unto the grid until all the statements were ranked. They were then given the opportunity to re-rank the statements if they were not satisfied with how they initially ranked them. Once they were done ranking the statements, the participants could submit their rankings for analysis. In concluding the Q-sorting, participants were required to fill in the survey, filling in their biographical and demographical information and responding to a few questions on reclaimed water, to assess their knowledge about the topic.

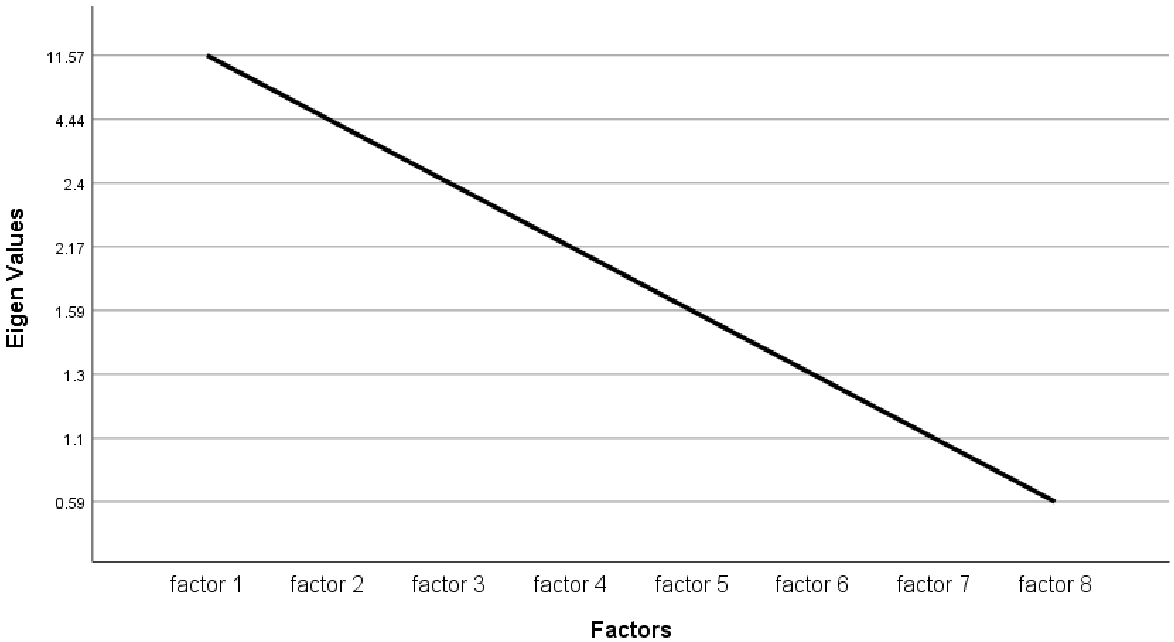
4. 10 Data analysis

A Q-factor analysis was conducted using the online Ken-Q software. According to Fincheliscu and Muthal (2018), a Q-factor analysis correlates the responses of different people, factoring out the groups of people who hold similar viewpoints. This contrasts with the more familiar R-factor analysis which correlates measures or items for a sample of people, factoring out clusters of items (Fincheliscu & Muthal**,** 2018). With a Q-factor analysis, first a correlation matrix of the participants' rankings was conducted, whereby the correlation coefficients produced showed the extent to which the participants exemplified a factor (Finchilescu & Muthal, 2018). The correlation coefficients produced for the eight factors ranged from 0.5 to 0.7, which met the criterion of -1 to +1 which was suitable for the pearson correlation criterion, of the coefficient ranging from -1 to +1. These correlation coefficients showed the degree to which the person exemplified the factor. This indicates that all the participants in the study exemplified each of the eight factors.

Table 3: Eigen values

	Factors							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Eigen Values	11.57	4.44	2.40	2.17	1.59	1.30	1.10	0.59
Percentage Variance explained	27	10	6	5	5	5	4	4
Number of significant Q-sorts	27	9	4	4	5	2	4	1

Two highest loadings (ignoring signs)	0.78	0.66	0.60	0.41	0.44	0.34	0.44	0.51
	0.8716	0.6516	0.53	0.41		0.34	0.45	
Cross product of highest loadings	0.68	0.429	0.32	0.17		0.12	0.20	



Scree test: figure 3

Secondly, a factor extraction was conducted. As per the Ken-Q rules, only 8 factors could initially be extracted. Using the principal components, 8 factors were extracted. In deciding the final number of factors that should be extracted, the researcher followed three rules. The first rule used was Kaiser-Guttman's criterion, which states that the eigen value of each factor must be greater than 1. According to Finchilescu and Muthal (2018), eigen values are the sum of squares of each of the factor loadings. It also refers to the amount of variability that a factor explains. The researcher can use the scree test to select the number of final factors to extract. According to Finchilescu and Muthal (2018), using the scree test, the researcher needs to graph the eigen values of all the factors from the largest to the smallest. In selecting the final factors, the researcher can select factors where the slope of the line changes (Finchilescu & Muthal, 2018).

As indicated in Table 3 above, the eigen values of all factors were greater than 1 which made all the factors ideal for extraction. The eigen values were then plotted on the scree test in order to select the final factors based on the slope of the line changing. However, the scree test could not be used due to the slope of the line not changing, hence the second rule which was Brown's formula was used in selecting the final factors. Brown's formula states that a factor should have two or more participants with significant loadings. In assessing whether factors had significant loadings, Brown's formula was used to calculate the significance **(**Finchilescu & Muthal, 2018**)**

Equation 1: Significant loading = (z-score at the .01 level) × (Standard error of the study)

$= \pm 2.58 \times (1/\sqrt{}$ (no. of statements in the Q-set))

Significant loading $= \pm 2.58 \times (1/\sqrt{40})$

$= \pm 2.58 \times (0.15811)$

$= 0.4079$

This was rounded to ± 0.41

As shown in the calculations above, the significant loading value was ± 0.41. This value was then used to analyse whether each of the factors had two or more participants with a significant loading that was equal to or greater than ± 0.41.

The third rule that was used is Humphrey's rule, which is a stricter procedure for determining whether the factors are significant. According to Finchilescu and Muthal (2018), Humphrey's rule states that "a factor is significant if the cross-product of the two highest loadings in the factor (ignoring negative signs) is greater than twice the standard error in the study" (Finchlescu & Muthal, 2018; p.138). As indicated in Table 3 above, the cross product for Factor 1 to Factor 3 were calculated and , they were greater than the standard error $(1/\sqrt{40}) = 0.158 \times 2 = 0.316$. The cross product of the highest loadings of Factor 1, 2 and 3 were greater than 0.316. Therefore, in selecting the final number of factors to extract, Factor 1 to Factor 3 were ideal for extraction as they met all three rules, whilst Factor 4 only met two rules, specifically Brown's significant loading as well as Kaiser-Guttman's criterion, which made it a candidate for extraction.

The next step that was conducted was factor rotation. Using the four final factors extracted, a varimax rotation was applied. According to Finchilescu and Muthal (2018), the process of rotation involves realigning the participants to get a better understanding on their membership in the factors. Once the rotation procedure was conducted, flagging was conducted, in which the researcher decided which of the 43 participants should be used as the best estimate of the factor. Factor loadings in the rotated matrix were used to select the final number of participants that were to be used for analysis. In deciding which participants to keep, the significant loading of ± 0.41 was used. Participants with factor loadings greater than ± 0.41 were selected. As indicated in Table 4, the number of participants that loaded significantly on Factor 1 were 14. In Factor 2, 10 participants loaded significantly, in Factor 3, seven participants loaded significantly whilst in Factor 4, five participants loaded significantly. Participants that loaded significantly on more than one factor were excluded. These participants are known as confounded. Participants that were insignifant were excluded all together, they were not analysed further.

Table 4: Summary of the categorised Q-sorts

	Participant's identifying numbers	**No.**	**Eigen values**	**Variance explained (%)**
Factor 1	1, 5, 8, 12, 13, 14, 15, 16, 21, 23, 26, 29, 31, 40	14	11.57	27
Factor 2	3, 6, 11, 19, 20, 22, 27, 28, 30, 32	10	4.44	10
Factor 3	2, 9, 18, 25, 35, 39, 42	7	2.40	6
Factor 4	4, 17, 37, 38, 41	5	2.17	5
Confounded	10	1		
Insignificant	7, 24, 33, 34, 36, 43	6		

The Ken-Q online software calculated the composite reliability of each factor as shown in Table 5 According to Du Plessis (2005), factors with a composite reliability between 0.80 to 0.90, indicate that the factor is defined by at least five participants.

Table5: Composite Reliability

	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Q-sorts	14	11	7	5
Average Relational Cofficient.	0.8	0.8	0.8	0.8
Composite Reliability	0.982	0.978	0.966	0.952
S.E. of Factor Z-scores	0.134	0.148	0.184	0.219

Chapter 5

Results

This section aims to provide the analysis of the data analysis results of the Q-sort of the participants. The results obtained from the survey on participants' knowledge of wastewater and reclaimed water will be discussed. Lastly, the results from the Q-sorts will be discussed, specifically looking at the way the participants ranked the statements in each of the four factors. Tables of the results will be provided.

5.1 Knowledge of Wastewater And Reclaimed Water

For this study, participants were further assessed on their level of knowledge on reclaimed water and recycled water. From the results shown in Table 6 below, 60% (24) indicated that they were aware of buildings that used reclaimed water, whilst 40% (16) of the participants indicated that they were not aware of any buildings that used reclaimed water. Regarding the participants' level of knowledge of reclaimed water, 45% (18) of the participants indicated that they knew what reclaimed water was, whilst 15% (6) perceived reclaimed water to be wastewater that has been treated to drinkable standards whilst the other 15% (6) indicated that reclaimed water is wastewater treated up to non- drinkable quality. Only 7.5% (3) indicated that they had no knowledge of what reclaimed water was. Regarding the participants' level of knowledge of wastewater, 95% (38) selected the appropriate meaning for wastewater, which shows that most of the participants were knowledgeable on the definition of wastewater. Only 5% (2) perceived wastewater as being rainwater that is not stored in tanks, which shows that they lacked knowledge on the meaning of wastewater.

Table 6: Awareness and Knowledge

Awareness of building that uses reclaimed water	Frequencies	Percentage (%)
Yes (Aware)	24	60
No (Not Aware)	16	40
Knowledge		
The term 'reclaimed water' means.		
1. Wastewater that has been treated	18	45
2. Wastewater that has been treated to drinkable quality	6	15
3. Wastewater is treated to non-drinkable quality	6	15
4. All of the above	3	7.5
5. I do not know	2	5
Wastewater		
1. Used water from any combination of home, business, or industrial activities, surface run off or storm water	38	88
2. Rainwater that is not harvested in tanks	5	11

5.3 P-Factor analysis

In this section, the researcher interprets the four final extracted factors, by specifically looking at where the factors were ranked in the statement. The researcher also looked to identify the most prevalent factors to highlight the factors that may influence building facilities managers. The researcher used the factor array and "crib sheet" to interpret each of the factors. A crib sheet is a form of guide in terms of how participants ranked their statements and which of the 43 statements wre insigificant and held no meaning to the participants. In interpreting the four extracted factors, the researcher interpreted the two statements placed at the -5 and +5 grids first, followed by the other rankings. The ranking system used for this study ranged from -5 to+5, with -5 to -4 representing strongly disagree with the statement, -3 to -1 representing disagree with the statement, 0 representing neutral, with 1 to 3 representing agree with the statement, and lastly, 4 to 5 representing strongly agree with the statement. Furthermore, the researcher assessed the distinguishing statements, consensus statements, as well as the descending array of differences. According to Du Plessis (2015), distinguishing statements also known as DSL are dependent on the number of Q-sorts that define a factor and on the standard deviation of the Q-sort distribution. In analysing the distinguishing statements, statements that were ranked on +5 and -5 and were significant at $p<0.05$ level were analysed, as they distinguished each factor from each other. As indicated by Table 7, Participants in Factor 1, ranked statement 8 on strongly agree compared to participants in Factor 2, 3, and 4, who placed this statement on 3, -3, and 0. This indicates that compared to participants in Factor 2, 3, and 4, participants in Factor 4, strongly believed that reclaimed water can be treated up to standards appropriate enough for different levels of use. Participants in Factor 1, ranked statement 2 on -5, compared to participants in Factor2, 3,and 4 who ranked the statement on -4,-3,-2. In Factor 2, statement 7 was placed on +5 and it was significant at $p<0.05$ level, compared to participants in Factor1, 3, and 4, who ranked the statement on -1, -3, and -3. Therefore, compared to participants in Factor 1, 3 and 4, the participants in Factor 2, strongly agreed that municipalities may fail to report on failures at treatment facilities. Participants in Factor 2, indicated that they have never been responsible for a buildng that uses reclaimed water, strongly disagreeing with statement 14, ranking it on -5, compared to participants in Factor 1, 3, and 4. Participants in Factor 3, ranked statement 21 on the +5 compared to participants in Factor 1, 2, and 4, who ranked on 0, 2, and 1. This meant that participants in Factor 3, strongly agreed that reclaimed water could lead to waterborne diseases being contracted if not treated up to quality standards. Statements ranked on -5 in this factor were insignificant and were not distinguished from Factor1, 2, and 4. Participants in Factor 4 ranked statement 22 and 26 on the +5 grid, which were significant at $p<0.05$ level, compared to participants in Factor 1, 2, and 3 who ranked statement 22 on 3, -4. This meant that participants in Factor 4, strongly agreed that the right water technology can treat reclaimed water up to quality standards and they indicated that they strongly agreed their tenants would find drinking reclaimed water to be repulsive and ranking statement 26 on -1, -1, and 0. However, the statements ranked at -5 level in this factor were not significant and were not distinguished from other factors. Acccording to Du Plessis (2015) consensus statements are perceived as not having any significant difference between the factors, due to all the factors providing the statements with similar scores. The results indicated that there were not consensus statements in each of the factors.

Table 7:Distinguishing Statements

Statements	**Factor1 ranking**	**Factor 2 ranking**	**Factor 3 ranking**	**Factor 4 ranking**
8 It is possible to treat wastewater to standards appropriate for different levels of reuse.	+5	+3	-3	0
2 Reclaimed water is not a sustainable option.	-5	-4	-3	-2
7 Municipalities may not be forthcoming with failures to reclaimed water treatment plants if / when they happen.	-1	+5	-3	-3
14 I have been personally responsible for a building where reclaimed water was used.	1	-5	-3	-3
21 Reclaimed water use could increase chances of waterborne diseases if not adequately treated.	0	+2	+5	+1
22 With the appropriate water technology, reclaimed water can be treated to drinking water standards	+3	-4	-4	+5
26 Drinking reclaimed water would be repulsive to tenants of the buildings I manage.	-1	-1	0	+5

5.3.1 Perceptions toward reclaimed water

5.3.1.1 Factor 1

Table 8:Factor 1

Variables	**Statement number**	**Statements**	**Statement ranking**
Quality	13	It is possible to treat wastewater to standards appropriate for different levels of reuse	+5
Health risk	26	If sufficiently treated, reclaimed water does not pose any health risks	+5
Health risk	24	Reclaimed water contains chemicals that could pose health risks to consumers	-3
Health risk	27	Reclaimed water use could increase chances of waterborne diseases if not adequately treated.	0
Cost	8	Investment in reclaimed water plants may entail high initial costs, but it would provide benefits for businesses in the long term	+4
Cost	4	A reclaimed water treatment system would be a strategic investment for commercial buildings to deal with projected water scarcity	+4
Cost	6	The cost of treating and supplying reclaimed water would be lower compared to that of regular water	0

Cost	9	Reclaimed water use carries legal and financial risks if supplied water does not meet set standards.	0
Trust	10	Staff at my local water authority are not skilled enough to ensure the safety of reclaimed water.	0
Knowledge	15	I am not sure about the processes involved in the treatment of wastewater.	-5
Knowledge	18	I know of a building where reclaimed water is currently in use.	+4
Knowledge	17	Better informed consumers would be less resistant to using reclaimed water.	-2
Disgust	20	The use of reclaimed water in commercial buildings, for whatever purpose, is disgusting.	-5
Disgust	22	Drinking reclaimed water would be repulsive to tenants of the buildings I manage.	-2
Policy	39	Reclaimed water use is not feasible because there is no national reclaimed water policy	-3
Sustainability	2	Reclaimed water is not a sustainable option	-5
Sustainability	1	Reclaimed water can reduce the demand for municipal water	+1
Technology	29	The potential for technology failure presents too high a risk for reclaimed water use	-2
Power	32	Decisions regarding reclaimed water use should be made by businesses and building owners, not facilities managers.	-1

Acceptable use	35	Direct potable use is not acceptable to my tenants (i.e. adding reclaimed water to the drinking water distribution system).	-2
		Distinguished	
Technology	28	With the appropriate water technology, reclaimed water can be treated to drinking water standards	
Health risk	25	Health concerns are the primary reason I would disallow the use of reclaimed water in my building.	
Knowledge	15	I am not sure about the processes involved in the treatment of wastewater.	
Knowledge	19	I have been personally responsible for a building where reclaimed water was used.	
Institutional trust	12	Municipalities may not be forthcoming with failures to reclaimed water treatment plants if / when they happen.	

Table 8 above represents the crib sheet for Factor one, which indicates how some of the statements in Factor one were ranked. Based on the results illustrated in Table 8 above and the factor array for Factor one (see appendix E), participants in this factor seemed to be influenced by knowledge, policy, acceptable uses, cost, power, health, technology, quality and sustainability. They each held varied perceptions toward the themes mentioned above that characterised Factor 1.

Participants in Factor 1 indicated that they would use reclaimed water if it were treated up to an appropriate quality standard. Hence, they agreed that reclaimed water is an investment that would be beneficial for the business and it would assist their building facilities curb water scarcity in the future. The individuals in this factor strongly agreed that reclaimed water was a sustainable option hence they perceived reclaimed water as entailing benefits for their building facilities. They felt that reclaimed water would contribute to the reduction in demand for municipal water use. Participants acknowledged that their tenants would find the use of reclaimed water to be repulsive, but they themselves rejected the thought of reclaimed water as being disgusting and did not think of it as containing human waste. This may be attributed to the knowledge they had regarding a building that utilised reclaimed water, which may also be the reason why they shunned the term "toilet to tap" to describe reclaimed water.

Moreover, the participants in this factor believed that technology that can treat reclaimed water up to quality standards exists. They believed that the water treatment technology would not have potential failures. As a result, participants believed that if reclaimed water was treated up to a quality standard it would not pose any form of risk to their health. Thus, they rejected the thought of reclaimed water containing chemicals harmful to one's health. Additionally, the perceptions held toward reclaimed water by participants in Factor 1 were positive, hence, the participants may have felt that using reclaimed water was possible regardless of lack of national policy in South Africa.

5.3..1.2 Factor 2

Table 9: Factor 2

Variables	**Statement number**	**Statements**	**Statement ranking**
Trust	12	Municipalities may not be forthcoming with failures to reclaimed water treat-ment plants if / when they happen	+5
Trust	10	Staff at my local water authority are not skilled enough to ensure the safety of reclaimed water.	0
Disgust	22	Drinking reclaimed water would be repulsive to tenants of the buildings I man-age.	+5
Disgust	20	The use of reclaimed water in commercial buildings, for whatever purpose is disgusting	+3
Disgust	21	Reclaimed water still contains human waste, regardless of how purified it is	0

Health risks	24	Reclaimed water contains chemicals that could pose health risks to consumers	+4
Power	31	As things stand, building facilities managers have no say on where the water supplied to commercial buildings is sourced from	+1
Power	33	Building facilities managers should be able to influence decisions around reclaimed water use in the buildings they manage.	+3
Acceptable use	34	My tenants would find the use of reclaimed water for non-contact uses acceptable (e.g. flushing toilets, gardening and air conditioning).	+4
Acceptable use	36	The use of reclaimed water for cleaning would be acceptable to my tenants (i.e. floors, bathrooms, and surfaces	+4
Sustainability	1	Reclaimed water can reduce the demand for municipal water.	0
Health risks	26	If sufficiently treated, reclaimed water does not pose any health risks	-1
Technology	28	With the appropriate water technology, reclaimed water can be treated to drinking water standards	-4
Technology	29	The potential for technology failure presents too high a risk for reclaimed water use	+1
Cost	6	The cost of treating and supplying reclaimed water would be lower compared to that of regular water	-4

Cost	7	Reclaimed water use would be an efficient way for building facilities to manage their water use costs.	-1
Cost	8	Investment in reclaimed water plants may entail high initial costs, but it would provide benefits for businesses in the long term	+4
Scale	38	Small-scale reclaimed water treatment (i.e. per building) would be more effective than larger treatment plants at municipality level.	-3
Knowledge	19	I have been personally responsible for a building where reclaimed water was used.	-5
Knowledge	18	I know of a building where reclaimed water is currently in use	-4
		Distinguished	
Cost	6	The cost of treating and supplying reclaimed water would be lower compared to that of regular water	
Scale	38	Small-scale reclaimed water treatment (i.e. per building) would be more effective than larger treatment plants at municipality level.	
Cost	7	Reclaimed water use would be an efficient way for building facilities to manage their water use costs.	
Health risk	26	If sufficiently treated, reclaimed water does not pose any health risks.	

Health risk	25	Health concerns are the primary reason I would disallow the use of reclaimed water in my building.	
Disgust	21	Reclaimed water still contains human waste, regardless of how purified it is.	
Knowledge	16	The phrase toilet to tap is appropriate for describing reclaimed water.	
Quality	13	It is possible to treat wastewater to standards appropriate for different levels of reuse.	

Based on Table 9 above and the Factor 2array (**s**ee appendix F) above showing the rankings for Factor 2, most of the participants in this factor were characterised by trust, disgust, acceptable use, power, cost, health risks, knowledge,technology, and scale.

The building facilities managers in this factor strongly believed that the tenants in their building would be repulsed by the thought of using reclaimed water for all their purposes. They felt a sense of disgust toward the use of reclaimed water for whatever purpose within commercial buildings. In some sense, they generalised that their tenants would be repulsed by reclaimed water as much as they find it to be repulsive. This may be attributed to their lack of knowledge of a building that uses and treats reclaimed water. They indicated that consumers that had some form of knowledge on reclaimed water would be less resistant to using reclaimed water. Hence, they perceived their participants as being repulsed by the thought of using reclaimed water.

Furthermore, the individuals in this factor believed that the technology used to treat reclaimed water may likely malfunction, resulting in the use of reclaimed water being risky. This was reinforced by the perception that the water technology may not be able to treat reclaimed water up to an appropriate quality standard. Hence, they believed that the use of reclaimed water may pose health risks for their tenants and themselves regardless of being treated up to a quality standard. Thus, they also felt that the use of reclaimed water for non-contact purposes such as gardening, flushing toilets, and air condition was acceptable. The negative perception held toward the use of reclaimed water may be attributed to the lack of trust held by the participants toward the staff at their local water authority. They strongly believed that their local staff may fail to properly treat reclaimed water up to a standard that is of appropriate quality. Their lack of trust towards their local water authority may be the reason why they felt that they, as building facilities managers, needed to have some form of influence on the decision made around the use of reclaimed water within their buildings. They may have felt that they needed the power to decide whether reclaimed water can be used within their buildings. They indicated that building facilities managers did not make any decisions on where reclaimed water can be sourced from. Hence, they may have felt the need to have the power to make decisions as well. Like the individuals in Factor 1, the individuals in this factor felt that investing in reclaimed water would be beneficial. They did however indicate that they perceived reclaimed water as not being of low cost compared to regular water. Regardless of reclaimed water being a beneficial investment, the participants felt that the use of reclaimed water would not help them to manage their water costs. Hence, they may have felt that treatment of reclaimed water at a small-scale level (per building) would not be effective compared to larger treatment plants at a municipality level.

5.3.1.3 Factor 3

Table 10: Factor 3

Variables	**Statement number**	**Statements**	**Statement ranking**
Quality	14	Reclaimed water should be judged by its quality not its history.	+5
Quality	13	It is possible to treat wastewater to standards appropriate for different levels of reuse.	-2
Disgust	22	Drinking reclaimed water would be repulsive to tenants of the buildings I manage.	+5
Health risks	25	Health concerns are the primary reason I would disallow the use of reclaimed water in my building	+2

Power	33	Building facilities managers should be able to influence decisions around reclaimed water use in the buildings they manage	+3
Cost	6	The cost of treating and supplying reclaimed water would be lower compared to that of regular water	0
Cost	9	Reclaimed water use would be an efficient way for building facilities to manage their water use costs	+4
Cost	8	Investment in reclaimed water plants may entail high initial costs, but it would provide benefits for businesses in the long term.	+4
Cost	7	Reclaimed water use carries legal and financial risks if supplied water does not meet set standards.	+4
Cost	5	To increase buy-in from users, reclaimed water should be cheaper than regular water	-1
Policy	40	Reclaimed water use is not feasible because there is no local reclaimed water policy	0
Institutional Trust	10	Staff at my local water authority are not skilled enough to ensure the safety of reclaimed water	-2
Technology	28	With the appropriate water technology, reclaimed water can be treated to drinking water standards.	-4
Scale	37	Reclaimed water use would be more effective if implemented at the municipality level rather than at building level.	-4

Knowledge	17	Better informed consumers would be less resistant to using reclaimed water.	+2
Knowledge	16	The phrase toilet to tap is appropriate for describing reclaimed water	-5
Knowledge	19	I have been personally responsible for a building where reclaimed water was used.	-5
Acceptable uses	35	Direct potable use is not acceptable to my tenants (i.e. adding reclaimed water to the drinking water distribution system).	+3
Quality	13	It is possible to treat wastewater to standards appropriate for different levels of reuse.	-3
		Distinguished	
Knowledge	18	I know of a building where reclaimed water is currently in use.	
Disgust	22	Drinking reclaimed water would be repulsive to tenants of the buildings I manage.	
Institutional Trust	12	Municipalities may not be forthcoming with failures to reclaimed water treatment plants if / when they happen.	
Disgust	24	Reclaimed water still contains human waste, regardless of how purified it is.	
Quality	13	It is possible to treat wastewater to standards appropriate for different levels of reuse.	
Institutional Trust	10	Staff at my local water authority are not skilled enough to ensure the safety of reclaimed water.	

Health risk	26	If sufficiently treated, reclaimed water does not pose any health risks.	
Scale	38	Small-scale reclaimed water treatment (i.e. per building) would be more effective than larger treatment plants at municipality level.	
Policy	40	Reclaimed water use is not feasible because there is no local reclaimed water policy.	
Scale	37	Reclaimed water use would be more effective if implemented at the municipality level rather than at building level.	
Cost	5	To increase buy-in from users, reclaimed water should be cheaper than regular water.	

Based on the results shown in Table ten above and the Factor 3 array (see appendix F), participants in this group were characterised by knowledge, quality, scale, institutional trust, policy, technology, power, health risks and cost. The results for Factor 3 showed that the individuals in this factor strongly believed that reclaimed water should rather be judged by its quality rather than its history, hence they indicated that reclaimed water that is not treated up to quality standard may result in a person contracting waterborne diseases. However, the participants in this factor showed that reclaimed water would less likely be used due to the health concerns they have. This may be attributed to the perceptions held toward water treatment technology. The participants believed that proper technology capable of treating reclaimed water up to quality standards is yet to exist. Furthermore, participants in this factor indicated that they were not aware of any buildings that used reclaimed water and indicated that they lacked experience in the management of a building that treated reclaimed water, which may be the reason why they had health concerns about using reclaimed water because they lacked first-hand experience in the treatment and reuse of reclaimed water.

Furthermore, the individuals in this factor rejected the term “toilet to tap” to describe reclaimed water. They strongly disagreed, perceiving the term as being inappropriate for describing what reclaimed water is or the process of producing reclaimed water. Thus, they believed that consumers in their buildings with some form of knowledge on reclaimed water, may be more open to using reclaimed water compared to those who lacked knowledge. They may be less resistant and more willing to adopt reclaimed water for whatever necessary purpose within their buildings. Therefore, this may have contributed to the perception held toward reclaimed water being an investment. The building facilities managers in this factor perceived that reclaimed water was an investment that would contribute to their building facility saving costs. They did, however, acknowledge that the lack of proper treatment for reclaimed water may contribute to them having a legal and financial impact. They believed that reclaimed water would not be cheaper than regular costs. Finally, the individuals in this factor were not convinced that the treatment of reclaimed water at a municipal level would be much more effective than at a building level. Similar to participants in Factor 2, the participants in this factor believed that as building facilities managers, they need to have some influence on the decisions taken around the issue of reclaimed water adoption for their building facilities.

5.3.1.4 Factor 4

Table 11: Factor 4

Variables	**Statement number**	**Statements**	**Statement ranking**
Technology	28	With the appropriate water technology, reclaimed water can be treated to drinking water standards	+5
Technology		The technology to safely produce reclaimed water from wastewater does not exist yet	-5
Power	32	Decisions regarding reclaimed water use should be made by businesses and building owners, not facilities managers.	+5

Power	33	Building facilities managers should be able to influence decisions around reclaimed water use in the buildings they manage	+3
Power	31	As things stand, building facilities managers have no say on where the water supplied to commercial buildings is sourced from.	-2
Power	33	Building facilities managers should be able to influence decisions around reclaimed water use in the buildings they manage.	0
Sustainability	3	Reclaimed water may be a more reliable alternative compared to groundwater and rainwater in the context of climate change.	+4
Knowledge	15	I am not sure about the processes involved in the treatment of wastewater.	0
Knowledge	17	Better informed consumers would be less resistant to using reclaimed water	0
Cost	6	The cost of treating and supplying reclaimed water would be lower compared to that of regular water	0
Cost	7	Reclaimed water use would be an efficient way for building facilities to manage their water use costs	+4
Scale	37	Reclaimed water use would be more effective if implemented at the municipality level rather than at building level.	+2
Policy	39	Reclaimed water use is not feasible because there is no national reclaimed water policy	+1
Policy	40	Reclaimed water use is not feasible because there is no local reclaimed water policy	-1

Institutional Trust	12	Municipalities may not be forthcoming with failures to reclaimed water treatment plants if / when they happen.	-3
Disgust	21	Reclaimed water still contains human waste, regardless of how purified it is	-4
Health risks	25	Health concerns are the primary reason I would disallow the use of reclaimed water in my building	-4
Acceptable uses	36	The use of reclaimed water for cleaning would be acceptable to my tenants (i.e., floors, bathrooms, and surfaces).	-1
Knowledge	16	The phrase toilet to tap is appropriate for describing reclaimed water.	-5
		Distinguished	
Disgust	22	Drinking reclaimed water would be repulsive to tenants of the buildings I manage.	
Cost	8	Investment in reclaimed water plants may entail high initial costs, but it would provide benefits for businesses in the long term.	
Acceptable uses	36	The use of reclaimed water for cleaning would be acceptable to my tenants (i.e. floors, bathrooms, and surfaces).	
Power	31	As things stand, building facilities managers have no say on where the water supplied to commercial buildings is sourced from.	

Cost	6	The cost of treating and supplying reclaimed water would be lower compared to that of regular water	
Knowledge	17	Better informed consumers would be less resistant to using reclaimed water.	
Quality	13	It is possible to treat wastewater to standards appropriate for different levels of reuse.	
Institutional Trust	12	Municipalities may not be forthcoming with failures to reclaimed water treatment plants if / when they happen.	
Knowledge	18	I know of a building where reclaimed water is currently in use.	

Based on the results presented in Table eleven above, participants in Factor 4 were characterised by technology, power, scale, health risks, cost, policy, institutional trust, and knowledge. The individuals in this factor strongly believed that the proper water treatment technology could ensure that reclaimed water was treated up to quality standard. Hence, they thought of reclaimed water as being a sustainable option and as being a more reliable water source compared to other water sources. It appeared that the participants perceived water technology as contributing to reclaimed water being a sustainable option. However, most of the participants felt strongly that there was no technology that could safely treat and produce reclaimed water. Thus, this may have contributed to the health concerns held by the participants toward the use of reclaimed water within their building. Hence, they would disallow the use of reclaimed water in their building.

Moreover, the participants strongly rejected the term “toilet to tap” to describe reclaimed water. They felt that reclaimed water did not contain human waste regardless of being treated up to quality standard. The individuals in this factor rejected the thought of their municipality failing to inform them of any failures that may occur at the water treatment plants if they were to happen. They indicated that they had some form of trust in their municipality and they felt that the implementation of reclaimed water at a municipal level would be more effective compared to an implementation at a building level. However, they believed that the use of reclaimed water may not be possible due to the lack of national water policy. The individuals in this factor felt that the use of reclaimed water may be possible regardless of the lack of local reclaimed water policy, disagreeing with the statement. Furthermore, the individuals in this factor felt that the use of reclaimed water within their buildings would help their buildings manage their costs efficiently. They acknowledged that reclaimed water use may carry some legal and financial costs. The participants in this factor indicated that as building facilities managers they have a say in where their water supply can be sourced from, which varied from the individuals in Factors 1, 2 and 3 The individuals in this factor strongly preferred that the decisions regarding the building facilities should be made by the business rather than building facilities managers.

Chapter 6

6.1 Discussion

This chapter presents a discussion of key findings from this study. Specifically, it examines the four factors and the individuals in them, with respect to adoption of reclaimed water use in public buildings. From the data analysis four factors were identifiable and each of the four factors were characterised by themes, specifically knowledge; cost; disgust; quality; policy; acceptable uses; scale; institutional trust; technology; sustainability; health concerns; and power. These broad areas have been previously identified as influencing public perceptions and willingness to adopt reclaimed water use. The study looked to answer the following question.

What are the factors influencing perceptions and willingness to adopt reclaimed water use amongst building facilities managers?

Factor 1

Based on the results for Factor 1, the individuals clustered in this factor strongly felt that reclaimed water could be treated up to quality standards appropriate for any level of use. These findings were different from those by Doria (2010), who found that 34% of the respondents were concerned about the reclaimed water quality hence they felt that they may not be able to use it for any level of use. They were concerned that the use of reclaimed water may contribute to some health issues. The participants in this study, further indicated that they believed that reclaimed water could be treated up to high quality standards compareable to regular drinking water. This supported the study conducted by Carr, Potter, and Nortcliff (2011) which showed that direct reclaimed water users held a positive perception towards reclaimed water quality. Carr et al. (2011) suggested that perceptions held toward reclaimed water were independent of water quality because perceptions would be negative regardless of the high reclaimed water quality consumers may receive. However, the building facilities managers in Factor 1 in this study seemed to not be concerned about reclaimed water quality. This would explain the lack of health concerns amongst the individuals in this factor. The individuals in this factor strongly felt that reclaimed water that had been treated sufficiently would not pose any health risks to consumers. They disagreed that reclaimed water had chemicals that could pose health risks to consumers. This finding was not expected because the key findings were different from the findings from Hurlimann and Dolnicar (2016), who showed that most people were concerned about using reclaimed water because of health issues relating to chemical agents. Another study conducted by Zhu and Dou (2018), showed that the public was mostly concerned about using reclaimed water due to odour and health risks that may arise because of using reclaimed water. Therefore, the acceptance rate may have been low due to the public concerns relating to perceptions about health risks, colour, odour, and turbidity (Zhu & Dou, 2018).

Additionally, the lack of health concerns as a result of reclaimed water consumption may have contributed to the lack of disgust felt toward the use of reclaimed water. The individuals in this factor indicated that they would not be repulsed by the thought of using reclaimed water. They did not perceive the use of reclaimed water in commercial buildings to be repulsive. However, they felt that their tenants would find the thought of using reclaimed water to be repulsive. This was not consistent with previous studies, as they showed that disgust was more likely to make people use reclaimed water for activities that have little human contact, such as washing clothes, irrigation of lawns and parks rather than activities with human contact (Glick, Goldfarb, Heiger-Barnays, & Krine, 2019). They also showed that using reclaimed water would be less acceptable if it were to be used for activities such as cooking, drinking, and irrigating fresh produce. (Glick et al., 2019). In contrast to this, the results for Factor 1 indicated that building facilities managers do not find drinking reclaimed water as being repulsive. This shows that the use of reclaimed water for any level of use would be acceptable for their building facilities. Similarly, a study conducted by Glick et al. (2019), showed that 38% of their respondents would use reclaimed water for direct human consumption, specifically for drinking water. This figure seemed to support Garcia Cuerva et al's (2016) findings, whereby 43% of their participants were in support of drinking reclaimed water which showed that they did not perceive reclaimed water as being disgusting. The findings for Factor 1 were different from the study conducted by Rock et al. (2012), which found that 67% respondents would use reclaimed water to irrigate crops that were non-edible, and only 28% would irrigate vegetable crops, which indicates that disgust would influence most of the respondent's perceptions and willingness to use reclaimed water for any level of use. Hence, the adoption level may be low (Glick et al., 2019). According to Rozin, Haddad, Nemeroff, and Slovic (2015) most instances where people are disgusted by reclaimed water can be attributed to the "yuck-factor", which is a psychological feeling that is associated with wastewater, containing sewage and other sources of contagion. However, the results for Factor 1 showed that the building facilities managers in this factor were more willing to adopt reclaimed water for their building facilities, indicating that they were less likely to be influenced by disgust. This can be attributed to the level of knowledge they have regarding the use and treatment of reclaimed water.

As illustrated by the results for Factor 1, the participants for this factor strongly rejected the phrase "toilet to tap" to describe reclaimed water. The individuals in this factor may have been familiar with the term "reclaimed water" and the process involved in the treatment of reclaimed water, hence they may have felt that the term "toilet to tap" is not the best to describe reclaimed water and its processes. Dolnicar et al., (2011) indicated that being familiar with certain terms helps to mitigate the negative associations that the "yuck" factor may produce toward reclaimed water. Thus, the likelihood to use reclaimed water would not be affected by the description of reclaimed water. They also indicated that they had been previously responsible for a building that used reclaimed water. These findings seemed to support the study conducted by Dolnicar, Hurlimann, and Grun (2011), which showed that having previous experience with using reclaimed water increases the likelihood to utilise reclaimed water. This would explain the reason why the building facilities managers in this factor did not find the use of reclaimed water to be repulsive. They had the knowledge and an understanding of the use of reclaimed water in building facilities and saw first hand the benefits that it entails. As a result, the participants in this factor considered reclaimed water as being a sustainable option.

They perceived it as a sustainable water source that would help their building facilities have a reliable water supply. This supported the study that was conducted by Carr, Potter and Nortcliff (2011) which showed that direct reuse farmers agreed that having a continual supply of reclaimed water coming directly from wastewater treatment plants provided them with the opportunity to cultivate throughout the year, indicating that reclaimed water could be a sustainable option (Carr etal., 2011). Therefore, the participats in this factor would most likely be willing to adopt reclaimed water use as it would be a sustainable option compared to the other water sources. The results further suggest that the participants in this factor consider reclaimed water to be an investment that would benefit their businesses and would help to ensure that their building facilities would curb water scarcity in the future. This supported the findings of studies conducted by Kaercher et al.

(2003) and Marks et al. (2002) which found that public acceptance of reclaimed water was dependent on cost-benefits, which means participants were more willing to use reclaimed water if it would entail benefits for them. Contrastingly, the study conducted by Alhumoud et al. (2003) showed that the Kuwaiti public would be willing to pay more money for regular water to avoid using reclaimed water regardless of the benefits reclaimed water may hold. Similarly, Hurlimann and McKay (2007) showed that residents of a community that used recycled water for domestic non-potable use were willing to invest in reclaimed water regardless of the high costs if they would receive quality improvements in recycled water which would be purifed using water treatment technology. The results for Factor 1 further suggested that the individuals in this factor did not believe that water technology that could treat wastewater existed yet. This seemed to not be supported by the study conducted by Esposito, Tsuchihashi, Anderson, and Selstrom (2005), which indicated that respondents in their study perceived that technology that can treat reclaimed water existed. The participants in Factor 1 disagreed that potential technology failures that can lead to high risks in the use of reclaimed water could happen. Therefore, the individuals in Factor 1 would be influenced to adopt reclaimed water for their building facilities since they perceived it as an investment worth the benefits regardless of the high costs it may entail (Dolnicar & Schafer, 2009).

Factor 2

The individuals in this factor held more negative perceptions toward reclaimed water compared to the individuals in Factor 1. As demonstrated by the results for Factor 2, similar to the individuals in Factor 1, the participants in this factor dismissed the use of the phrase “toilet to tap” to describe reclaimed water. They found it to be inappropriate and may have felt that it did not highlight the entire process involved in the treatment of reclaimed water. Similar to the indiviuals in Factor 1, the individuls in this factor may have had some form of knowledge on reclaimed water and knew the best term that can be used to describe the process of reclaimed water that does not sound repulsive. Furthermore, individuals in this factor felt that consumers that are better informed were more likely to use reclaimed water compared to those who were less informed. Alhumoud et al. (2003) indicated that public responses toward reclaimed water confirmed that people lack knowledge of reclaimed water and the processes involved. Hence, they rejected the use of reclaimed water and found the term “toilet to tap” as being appropriate to describe reclaimed water.

This is in support of the survey conducted in Tianjin, which showed that Tianjin residents lacked basic knowledge on their water supply, which impacted their decision making (Zhu & Dou, 2018). For the residents to make decisions that are rational on water supply issues, their understanding of basic water supply needs to be better (Dolnicar et al., 2011). Therefore, as agreed upon by the building facilities managers in Factor 2, consumers that have knowledge of reclaimed water will most likely be willing to adopt it for any level of use. Having some form of knowledge on the water source can contribute to consumers being motivated to be in favour of reclaimed water. This indicates that the building facilities managers in this factor would most likely be influenced by knowledge to adopt reclaimed water for their building facilities. As most studies have shown (e.g., Po et al., 2003, 2005; Dolnicar et al., 2011; Rock et al., 2012; Hurlimann and Dolnicar, 2016; Kecinski and Messer, 2018a, Fielding et al., 2018), the public is not very receptive of using reclaimed water for domestic use or any level of use. As a result, willingness to adopt reclaimed water use was relatively low in Factor 2. The building facilities managers in Factor 2 also indicated that they had no knowledge of a building that used reclaimed water, and that they had never been responsible for a building that used reclaimed water. This meant that they had no experience of working with reclaimed water. This would explain the health concerns held by the individuals in this factor. The results for this factor suggest that the indivuals in this factor believed that reclaimed water posed health risks regardless of being sufficiently treated, which was in contrast to the individuals in Factor 1. The perceptions held by the individuals in this factor in clear support of the study conducted by Massoud et al. (2018) which showed that participants believed that the use of reclaimed water would result in waterborne diseases and affect human health, hence, they were less willing to use reclaimed water. Evidence further suggests that perceptions of health risks become prominent when reclaimed water is used for personal use and this may also evoke the feelings of disgust in people (Massoud et al., 2017).

Additionally, Factor 2 rankings for disgust were in contrast to those of Factor 1, with individuals in this factor being influenced by digust. As expected, the building facilities managers in Factor 2 found the thought of using reclaimed water to be repulsive. They strongly agreed that drinking reclaimed water was repulsive. These findings were in support of most of the studies that identified disgust as a prevalent factor in influencing perceptions and willingness to adopt reclaimed water use. For example, a study conducted by Massoud, Kazarian, Alameddine, and Al-Hindi (2018), found that the disgust felt toward reclaimed water strongly affects the willingness to adopt reclaimed water use. They found that participants were less willing to use reclaimed water for whatever purpose. In another study conducted by Dolnicar and Schäfer (2009), it was found that a third of the respondents found recycled water to be disgusting, which was a result of psychological repugnance (Fielding, Dolnicar, & Schultz, 2014). Thus, the disgust felt toward reclaimed water by the building facilities managers in this factor can be attributed to the law of contagion, whereby any item that has been in contact with a contaminated object is thought of as being contaminated as well, regardless of the item being thoroughly cleaned (Dolnicar, & Schultz, 2014). They would not drink reclaimed water regardless of being treated to quality standards.

Despite having feelings of disgust toward the use of reclaimed water, the individuals in this factor perceived reclaimed water as an investment that would provide long term benefits for their building facilities regardless of the high costs. However, they disagreed that the treatment and supply of reclaimed water would be lower compared to the cost of regular water. This contrasted with the survey conducted by Gu, Chen, Pody, Cheng, Zheng, and Zhang (2015), which showed that 48% of the Tianjin public perceived the costs of tap water to be high and they preferred the price of reclaimed water as it was substantially lower than that of tap water. Residents in Tianjin held the perception that the cost of reclaimed water would increase as it approached its perceived value. This indicates that 48% of the participants in their sample perceived reclaimed water as being costly. Therefore, regardless of the low costs that reclaimed water may entail, participants may not be willing to use reclaimed water due to the negative perceptions they already have towards reclaimed water (Gu et al., 2015). As illustrated by the results for Factor 2, the majority of the participants in this factor lacked trust in their municipalities. They strongly felt that their local municipalities may not let them know of the failures that may occur at the reclaimed water treatment plants. This indicates that the building facilities managers in Factor 2 lacked trust in their municipalities. This is not surprising, seeing the majority of South Africans lack confidence in the municipalities' service delivery (Ndevu & Muller, 2017). The results for Factor 2 confirmed the findings for a study conducted by Ravishankar, Nautiyal, and Sashaiah (2018), which showed that the public has low levels of trust in the government and the media. In their study, approximately

90% did not trust their current governmental authorities to ensure a proper operation of the wastewater treatment plant and ensure a safe delivery safe of high-quality water or even oversee the process ensuring that there were no failures. Ravishankar et al. (2018) also showed that 20% of their respondents did not trust their water providers to ensure that reclaimed water was treated up to quality standard. They did not trust the way the treatment would be carried out, the operations, and the efficiency of the treatment. According to Massoud et al. (2018), for the public to trust their government authorities, it all depends on whether credible information is provided regarding the treatment processes involved and the communication process relating to the wastewater treatment plant. The lack of trust in government authorities is due to risk judgments (Doria, 2010).

Moreover, the results for this factor further revealed that the particiants in this factor did not make the decisions on the source of their water supply for their building facilities which influenced their need for influential power. They felt that they should have the influential power over the decisions made in relation to the use of reclaimed water for their building facilities. This may have contributed to their need to have influence over the decisions made in relation to the use of reclaimed water for their building facilities. Carr et al. (2011) showed that respondents that had no control over when and where reclaimed water could be used, held negative perceptions towards the use of reclaimed water. Their study also showed that farmers that had a say in the treatment of wastewater and its implementation through direct sewage pipes held positive perceptions of reclaimed water. As discussed above, the building facilities managers in Factor 2, held a negative perception toward the technology that could treat reclaimed water, they assumed that the technology might fail and result in risks from using reclaimed water. This may be a result of their lack of decision making relating to the use of reclaimed water in their buildings. As a result, their willingness to adopt reclaimed water use may have been low compared to the building facilities managers who believed that the water treatment technology might not fail (Carr et al., 2011).

Factor 3

The participants in Factor 3, strongly felt that using reclaimed water that was not adequately treated could lead to an increase in waterborne diseases. They also agreed that health concerns would be the main reason why they would not want occupants in their building facilities to use reclaimed water. This was expected because a study conducted by Dolnicar (2014) showed that the percentage of people that were concerned about health risks related to reclaimed water varied from 5% to 92%. According to Massoud et al. (2017) perceptions of health risks often describe people's subjective judgement of behaviours or health risks. Therefore, health risk perceptions held by building facilities managers in Factor 3 were most likely to affect their level of acceptance toward reclaimed water use. They may have the perception that reclaimed water has chemicals and pathogens which may negatively impact their health. Thus, they felt that reclaimed water may not be treated up to quality standards, hence they also assumed that appropriate water technology would not treat reclaimed water up to quality standards. However, the participants in this factor felt that reclaimed water should be judged by its quality rather than history. These findings were different from several studies which showed that respondents were concerned about reclaimed water quality. For example, a study that was conducted by Doria (2010) found that about 34% of the respondents were concerned about using reclaimed water due to concerns about quality standards. They felt that reclaimed water may not be treated up to quality standard hence it may result in consumers having health issues. These were some of the concerns expected for this study. The participants also felt that using reclaimed water for low contact use is more acceptable compared to using it for high contact uses, which they found to rather be unacceptable. This supported the study conducted by Zhu and Dou (2018), who showed that people preferred using reclaimed water for low and intermediate body contact applications such as firefighting, irrigation, and landscape irrigation. They perceived these as acceptable uses. Zhu and Dou (2018) showed that the support for the use of reclaimed water and the degree of body contact of reclaimed water has been shown to be negatively correlated. The perception held towards the acceptable use of reclaimed water by the participants in this factor can be explained by the "yuck factor" which would contribute to the lack of acceptance amongst the participants in this factor. The participants in this factor may have felt some level of disgust toward reclaimed water when they thought about using it for high contact purposes hence they felt they would only use it for low contact use nd they also felt that reclaimed water may not be treated up to quality standards. Unlike the results for this factor, Hurlimann and Dolnicar (2009) found that 68% of the respondents were willing to drink recycled water that was mixed with reclaimed water and was treated to quality standards. Sydney Water (1991) found a similar acceptance rate (Hurlimann & Dolnicar, 2009).

Similar to the individuals in Factor 2, the participants in this factor perceived reclaimed water as carrying financial and legal risks if it failed to meet the set standards. They felt that using reclaimed water would not assist them to manage their costs, which may impact their willingness to adopt reclaimed water use. They did however perceive it as an investment that would assist in tackling projected water scarcity. These findings were different from the study conducted by Marks et al. (2002), which showed that a reduced water bill can contribute to the willingness to adopt reclaimed water use. Relatively low reclaimed water costs could result in more people having the willingness to use reclaimed water (Garcia-Cuerva et al., 2016). Regardless of considering reclaimed water as an investment they felt that it would not be effective to implement reclaimed water at a municipality level compared to a building level. This finding for Factor 3 was different from what Dolnicar and Hurlimann (2014) found. They showed that wastewater management could be put into practice at a large-scale and at a small-scale. They highlighted that scaling up to a country level or a building level would not be difficult since wastewater management and wastewater recycling had been partially implemented in some other parts of the world and in policy frameworks. Countries such as Australia, Singapore, and Israel have implemented water reclamation programs as a response to the growing agricultural water demands and rising water shortages (Dolnicar & Hurlimann, 2014). This shows that the implementation of reclaimed is possible at any level of scale (Ravishankar et al., 2018). Therefore, it is possible for South Africa to implement reclaimed water at different scale levels, which would show building facilities managers that the implementation of reclaimed at a municipality level is possible as much as it is at a building level.

In agreement with the individuals in Factor 1, the participants in this factor were strongly against the use of the term "toilet-to tap" to describe reclaimed water, which indicates that they have some familiarity with reclaimed water and its treatment process. The individuals in this factor agreed that consumers that are better informed on reclaimed water and its processes would be less resistant and more open to using it. This meant that consumers who were less informed on reclaimed water would be highly resistant to using reclaimed water. This was in support of the study conducted by Zhu et al. (2018), which showed that people in Shanong lacked a general understanding of various water sourcesincluding reclaimed water, hence they were less receptive of adopting reclaimed water use for domestic purposes. They felt that their tenants would find the addition of reclaimed water in the drinking water distribution system to be unacceptable. Similarly, Marks (2006) found that people felt it was acceptable to use reclaimed water for industrial cooling and irrigation of golf grounds. They found it to rather be unacceptable to use reclaimed water for vegetable crops and household gardens, which meant they would not consume crops that have been in contact with reclaimed water. This was attributed to the concerns held about health issues, such as chemical agents and pathogens that are related to reclaimed water. Hence opposition is often high when it relates to the adoption of reclaimed water (Zhu & Dou, 2018). Therefore, the evidence from this factor suggests that lack of knowledge would contribute to their tenants finding reclaimed water to be repulsive and would not be able to use it for activities that require high level contact. This means that they would still not be interested in using reclaimed water regardless of it being affordable. Furthermore, the participants for Factor 3 indicated that building facilities managers do not make any decisions on where the water source for the buildings could be sourced from. Thus, the building facilities managers in Factors 3 agreed that as building facilities managers they needed to have influential power over the decisions made in relation to the use of reclaimed water for their building facilities. As already highlighted above (Factor 1), having influential power on the decisions made contributes to more chances in the adoption of reclaimed water. This means that the individuals in this factor would be open to adopting reclaimed water use for their building facilities. Thus, the building facilities managers in this factor came across as having the willingness to adopt reclaimed water use.

Factor 4

The individuals in this factor strongly felt that the appropriate technology can treat reclaimed water up to drinking water quality standards. They believed that water treatment technology that treats reclaimed water safely does exist. Hence, they may have perceived reclaimed water as being more of a sustainable option compared to rainwater and groundwater. This supprtorted the study conducted by Campbell and Scott (2011), which showed that 84% of its respondents felt that the use of reclaimed water would assist in reducing the dependence on imported water. Broadly speaking, the individuals in this factor may have felt that reclaimed water was of sufficient quality and would be suitable for any level of use within their buildings. Hence, it would explain the lack of health concern because of using reclaimed water. The individuals in this factor highlighted that health concerns would not be the reason why they would disallow the use of reclaimed water in their building facilities. This was in contrast to a study conducted by Zhu and Dou (2018) which showed that low acceptance toward the use of reclaimed water reflected public concerns about health issues. Simarlaly, Chen et al. (2015) found that public health concerns contributed to their lack of acceptance in the adoption of reclaimed water. However, they indicated that their tenants would find it unacceptable to use reclaimed water for cleaning (i.e., floors, surfaces, and bathrooms). This was in support of most of the studies conducted on acceptable uses. For example, a study that was conducted by Zhu and Dou (2018), showed that people in three cities, specifically Weifang, Yantai, and Jinan strongly preferred using reclaimed water in applications such as flushing road dust, toilet flushing, washing cars, industrial cooling, and for landscape purposes. Most of the respondents were more accepting of using reclaimed water for non-potable uses, as shown by Dolnicar and Schafer (2009). Similarly to this study, the study conducted by Ormerod, Redman, and Kelley (2019), showed that the most prevalent influence on public acceptability for both potable and non-potable purposes is the level of personal contact which is referred to as the ladder of acceptance. Their survey research indicated that people preferred using reclaimed water in instances where there was very little personal contact. However, as the use of reclaimed water becomes more personal, the level of acceptance reduces (Ormerod et al., 2019). This shows that people were open to using reclaimed water if the level of personal use was low. The higher the chances of personal use of reclaimed water, the less acceptable it is, with most people opposing the use of reclaimed water for cooking, bathing, or drinking (Hurlimann & Dolnicar, 2009).

Similar to participants in Factor 1, they strongly rejected the use of the term “toilet to tap” as being appropriate for the description of reclaimed water, which would explain the reason they did not think reclaimed water contained human waste regardless of being purified. This was not in support of Chen, Bai, Zhang, Lyu, and Jiao (2015), who showed that terms such as “toilet-to-tap” and “recycled sewage” used for describing reclaimed water, painted a significant negative image in the adoption of reclaimed water in the general public, hence people become resistant toward the implementation of reclaimed water (Chen et al., 2015). However, as mentioned in Factor 1, having familiarity with terms helps moderate the negative correlation that the “yuck factor” produces toward reclaimed water. Hence, the likelihood of adopting reclaimed water is reduced.

Different from the individuals in Factor 2 and 3, the participants in this factor strongly approved of the business owners and building owners making decisions on the water use of the building facilities. They indicated that as building facilities managers they had no say in where their building's water supply should be sourced from, hence they hoped that as building facilities managers they would like to be involved in the decisions made and be able to influence some of the decisions made regarding the implementation of reclaimed water in the building facilities they manage. The individuals in this factor also believed that reclaimed water would contribute to building facilities managing their water use costs, hence, they would be open to investing in it and using it in their building facilities. Marks et al. (2002), showed that a reduced water bill can contribute to the willingness to adopt reclaimed water use. Relatively low reclaimed water rates could result in more people having the willingness to use reclaimed water (Garcia-Cuerva et al., 2016). Chen et al. (2015), states that water costs are important in the implementation of reclaimed water. This shows that investment in reclaimed water would be high if the reclaimed water rates are low and allow people to manage their overall water costs.

Nevertheless, the individuals in this factor acknowledged that the implementation of reclaimed water would be more effective if it were to be implemented at the municipality level rather than at a building level. Consequently, they trusted their municipality to be forthcoming about any failures they may face at the water treatment plants if they happen or when they happen. This was an anticipated finding because the majority of the individuals in South Africa are less trusting of their municipalities as well as their government officials (Ndevu & Muller, 2017). Dolnicar et al. (2014) states that trust in governmental groups is often low, resulting in low levels of acceptance of reclaimed water. Similar to the findings of this study, Dolnicar et al. (2014) showed that a small majority, ranging from 53% to 59% of the respondents, held the perception that providers (municipalities) could be trusted to deliver quality reclaimed water (Dolnicar et al., 2014). Trusting the authorities to manage risk in wastewater treatment plants is perceived as being an important factor in the perceptions and acceptance of reclaimed water (Muanda, Counsins, Lagardien, Owen, & Goldin, 2017). Thus, the building facilities managers in Factor 4 were most likely influenced by institutional trust, impacting their willingness to adopt reclaimed water use. Muanda et al. (2017) stated that having trust in authorities helps to enhance acceptability, indicating that people believed the treated reclaimed water was of a high quality. Therefore, the building facilities managers in this factor had trust in their local municipality, which meant they believed that their local municipality would treat reclaimed water up to quality standards. The individuals in this factor also indicated that the use of reclaimed water may not be possible due to the lack of national water policies in South Africa. This was in support of a study conducted by Zhu, Wang, and Li (2019), whereby they analysed reclaimed water policies in China. They found that regions with weak and moderate policy promotion used very little reclaimed water compared to regions that had strong policy promotion. This showed that introducing and promoting reclaimed water policies and regulations is important as it can help augment the use of reclaimed water in any region (Zhu et al., 2019). Thus, the public can be more open to using reclaimed water if water resource policies are successfully implemented (Zhu et al., 2019). Hence, the building facilities managers in Factor 4, could be open to using reclaimed water regardless of the lack of local reclaimed water policies.

In addressing each of the factors that may contribute to the unwillingness to adopt reclaimed water use amongst building facilities managers, factors such as disgust need to be addressed through sharing positive information and experiences about the quality of reclaimed water, the building facilities managers in Factor 2 may be willing to adopt reclaimed water (Zhu, Wang, & Li, 2019). The media and the Government need to start disseminating more information about reclaimed water and the reliability of the of processes involved in treating the water. This would provide people with the opportunity to gain knowledge on reclaimed water (Zhu, Wang, & Li, 2019). They will gain more understanding of the benefits of reclaimed water, which would address factors such as quality, sustainability, and acceptable uses. Zhu, Wang, & Li, (2019) state that specific actions such as leading people to site that provide more details to reclaimed water should be introduced as this would build people's confidence towards the use of reclaimed water. This will increase public acceptance of reclaimed water and building facilities managers in Factor 2 may be willing to adopt reclaimed water use for their building facilities (Zhu, Wang, & Li, 2019).

Socio-ecological model and Factors

In sum, the perception and willingness to adopt reclaimed water use amongst building facilities managers across the four factors was influenced by different components/themes. Each of these components/themes identified can be shown to form part of Bronfenbrenner's nested circles, each influencing the building facilities managers' perceptions toward the use of reclaimed water. The majority of the building facilities managers were influenced by knowledge, disgust, and institutional (dis)trust which all form part of the microsystem. These are the factors closest to them. The knowledge they had about buildings that use reclaimed water and their experience with being responsible for a building that used reclaimed water would influence their willingness to adopt reclaimed water use. This would also influence their feelings of disgust towards the use of reclaimed water. As indicated, most of the building facilities managers in this study found the use of reclaimed water, at whatever level, to not be repulsive. This may be due to the knowledge they have about reclaimed water and buildings that use reclaimed water. Therefore, this may have influenced their willingness to adopt reclaimed water use for drinking purposes within their building facilities. Regardless of having knowledge, the lack of information from their local municipality pertaining to the reclaimed water treatment process could contribute to building facilities managers lacking trust in their municipalities. Hence, they may hold a negative perception toward their local municipalities which would impact their willingness to adopt reclaimed water use. However, the building facilities managers in Factor 4 seemed to trust their local municipalities to be transparent about the process of treating reclaimed water. Either way, they were all influenced by some level of institutional trust. The health concerns that the building facilities managers in Factor 3 may have held toward the use of reclaimed water were more on a personal level which meant they formed part of their microsystem as well. The building facilities managers had different perceptions toward health concerns, participants in Factor 1 seemed to believe that reclaimed water would pose health risks whilst some did not seem to think it would. This would be attributed to their level of knowledge in relation to reclaimed water and its benefits, regardless of their level awareness of reclaimed water, their level of knowledge may have been poor, which would explain why the participants in Factor 2 held a more negative perception toward reclaimed water. Hence, their knowledge (microsystem) may have impacted other nesting circles. (Vest Ettekal & Mahoney, 2017).

The perceptions held towards cost, quality, sustainability, and technology all seemed to form part of the microsystem of the building facilities managers. Each of the building facilities managers seemed to be influenced by either of these four components/themes. Therefore, the microsystem had more of an influence compared to other systems. This was expected because the individuals in this study were mostly influenced by their microsystems. Within other systems such as the exosystem, we find that building facilities managers were influenced by policy. In this case, they were influenced by the lack of reclaimed water policy, specifically national policies. Contrastingly, some of the building facilities managers seem to not be influenced by policies, they seemed to think that the use of reclaimed water was possible regardless of the lack of local reclaimed water policies. Their perceptions seemed to not be influenced or guided by reclaimed water policies (Lee et al., 2017). According to Lee et al. (2017), the exosystem was more organisational or institutional, aggregating an individuals' interpersonal relations within the workplace. This brings us to the power component/theme. In this case, building facilities managers seemed to consider the decisions made by business owners regarding the use of reclaimed water would influence their willingness to adopt reclaimed water use. As shown above, the lack of control over the use of reclaimed water can contribute to a negative perception held to adopting reclaimed water use.

6.2 Practical Implications

The main aim of this study was to identify factors influencing the perceptions and willingness to adopt reclaimed water use amongst building facilities managers. This was done through the analysis of the participants' Q-sorts, which helped identify some of these factors that would influence the willingness to adopt reclaimed water use. The first practical implication of this study is the identification of the factors such as knowledge, disgust, health concerns, technology, policy, power, acceptable uses, sustainability, scale, and institutional trust that were shown to influence the willingness to adopt reclaimed water use amongst building facilities managers within the South African context. With these findings, this study contributed to the body of knowledge in South Africa on the topic of reclaimed water and the factors that hinder its successful introduction.

As highlighted in Chapter 4, the majority of the studies conducted using Q-methodology in South Africa have been conducted in the health field, specifically the medical field. Therefore, the second practical implication is that this study contributes empirical evidence that can be used in the Organisational Psychology context. This means that more organisations in South Africa, can use the key findings of this study that showed that factors such as knowledge, power to name a few to ensure that they address these factors through channels such as media or providing information and advantages of reclaimed water for the successful introduction of reclaimed water successfully within organisations in South Africa.

The study highlighted that South Africa lacks municipal and national water policies that would ensure that reclaimed water is used and treated up to quality standards. Therefore, the third practical implication of this study is that water policy makers must develop a water policy that ensures that the introduction of reclaimed water in commercial buildings is successful. The study's framework suggests that each of the factors that may influence the perceptions and willingness to adopt reclaimed water use amongst building facilities managers forms part of Bronfenbrenner's nested circles such as the microsystem, macrosystem, mesosystem, exosystem, and the chronosystem which were shown in the literature review to have some form of influence on the building facilities managers due to the factors identified forming part of the systems. With the use of this study's findings, building facilities managers are able to identify these circles within their building facilities and find ways to address them to ensure that the factors that may influence their tenants in not adopting reclaimed water use are addressed to ensure that reclaimed water is successfully introduced within their building facilities, whether it is for contactable or non-contactable uses.

6.3 Limitations

For this study, the researcher used an online Q-methodology software to capture the participants viewpoints. In using this method, the researcher was unable to interact with the participants. Most studies that have used Q-methodology, have used the paper-based Q-methodology, which allows them to have interviews with the participants after the Q-sorting procedure to get a better understanding of their viewpoints. Due to Covid-19, the researcher could not have close contact with the participants which meant interviews could not occur. The participants could not provide an explanation of their rankings to the researcher which would have assisted the researcher to have a better understanding of their viewpoints. In ranking the statements, participants were required to rank 40 statements onto a grid. The number of statements could have contributed to participant fatigue, resulting in the quality of Q-sort rankings deteriorating. Participants could have been bored halfway through ranking the statements, resulting in them ranking the statements anywhere on the grid and not according to what the statements meant to them. The sample size of the study was greater than the overall statements of the study. In the Q-methodology, the sample size is not meant to be bigger than the number of statements as this may take away the main purpose of the study which is to identify viewpoints from each participant. The study's components/themes had unequal statements, some of the components had more statements compared to others, for example cost. This may have impacted how some of the statements from other components were ranked impacting the overall factor array. With the study used 43 participants, the study cannot be generalised to the South African population of building facilities managers, as it is not representative of everyone.

6.4 Recommendations

Most of the studies conducted using the Q-methodology have focused on the acceptance of the public. Very few studies, if any, have been conducted in the context of commercial buildings. Therefore, it would be suggested that future studies start focusing on building facilities because the majority of people employed in building facilities spend most of their time at work and less time at home. Thus, it would be beneficial to start assessing whether building facilities would be willing to use reclaimed water and identify the factors that may impact the acceptance of reclaimed water in commercial buildings and building facilities. More studies using the Q-methodology need to be conducted in the South African context. This method would help researchers have a better understanding of their participants' perspectives whilst simultaneously helping them to identify certain issues relating to their topic of interest. South Africa has been shown to be a water scarce country and it would be beneficial to start conducting studies that will help identify the factors that may impact the willingness to use reclaimed water. This will contribute to the adopting of reclaimed water within the public as well as building facilities. In conducting a follow up study, it would be suggested that the focus now be on whether some of the participants still held negative perceptions and whether the participants knowledge on reclaimed water had been enhanced since the study had been conducted. Furthermore, studies investigating appropriate communication strategies in relation to reclaimed water and the factors that may influence willingness to adopt reclaimed water use should be conducted. This would provide building facilities managers with the idea of which communication strategy they should use in addressing each factor and ensure that their tenants become more open and willing to adopt reclaimed water use for any level of use both at work and their homes.

6.5 Conclusion

This study aimed to identify various factors that can influence the perceptions and willingness to adopt reclaimed water use amongst building facilities managers within the South African context. The study showed that most of the participants found reclaimed water to be worth investing in due to the benefits it may entail regardless of the high costs it may also entail. Participants seemed to indicate that reclaimed water was a sustainable option compared to ground water and rainwater which has been shown by several studies to not be sustainable due to climate change. The key findings of this study mostly supported findings from previous studies. The study showed that health concerns were amongst the factors that may contribute to building facilities managers' willingness to adopt reclaimed water use for their building facilities to be low. Some of the participants (those in Factor 2) had indicated that reclaimed water was repulsive whilst the majority indicated that it was not. This was surprisingly different from most studies because most of studies showed that their respondents found the thought of using reclaimed water for whatever purpose to be repulsive. Building facilities managers also indicated that they preferred using reclaimed water for non-potable uses which supported multiple studies. Some of the participants felt that they should have influential power on the decisions made regarding reclaime water. They may choose to adopt it for their buildings or they may choose another water source that they believe would sustain them. The participants of this study were each influenced by different factors holding different perceptions toward reclaimed water. Some of the participants (Factors 1 and 3) held a more positive perception toward reclaimed water whilst the participants in Factors 2 and 4 held a more negative perception toward reclaimed water. These findings met the assumptions made by Bronfenbrenner's theoretical framework, which showed that people are most influenced by the microsystem

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Appendix A: Q-Statements.

Statements	1	2	3	4	5	6	7	8	9	10
Sustainability										
1. Reclaimed water can reduce the demand for municipal water.										
2. Reclaimed water is not a sustainable option.										
3. Reclaimed water may be a more reliable alternative compared to groundwater and rainwater in the context of climate change.										
Cost										
4. A reclaimed water treatment system would be a strategic investment for commercial buildings to deal with projected water scarcity.										
5. To increase buy-in from users, reclaimed water should be cheaper than regular water.										
6. The cost of treating and supplying reclaimed water would be lower compared to that of regular water										
7. Reclaimed water use would be an efficient way for building facilities to manage their water use costs.										
8. Investment in reclaimed water plants may entail high initial costs, but it would provide benefits for businesses in the long term.										
9. Reclaimed water use carries legal and financial risks if supplied water does not meet set standards.										
Trust										

10. Staff at my local water authority are not skilled enough to ensure the safety of reclaimed water.										
11. Municipalities may not adequately maintain reclaimed water treatment plants, exposing users of reclaimed water to health risks.										
12. Municipalities may not be forthcoming with failures to reclaimed water treatment plants if / when they happen.										
Quality										
13. It is possible to treat wastewater to standards appropriate for different levels of reuse.										
14. Reclaimed water should be judged by its quality not its history.										
Knowledge										
15. I am not sure about the processes involved in the treatment of wastewater.										
16. The phrase toilet to tap is appropriate for describing reclaimed water.										
17. Better informed consumers would be less resistant to using reclaimed water.										
18. I know of a building where reclaimed water is currently in use.										
19. I have been personally responsible for a building where reclaimed water was used.										
Disgust										
20. The use of reclaimed water in commercial buildings, for whatever purpose, is disgusting.										
21. Reclaimed water still contains human waste, regardless of how purified it is.										
22. Drinking reclaimed water would be repulsive to tenants of the buildings I manage.										

23. The thought of reclaimed water being used for any form of activities in our buildings is repulsing.										
Health Risks										
24. Reclaimed water contains chemicals that could pose health risks to consumers										
25. Health concerns are the primary reason I would disallow the use of reclaimed water in my building.										
26. If sufficiently treated, reclaimed water does not pose any health risks.										
27. Reclaimed water use could increase chances of waterborne diseases if not adequately treated.										
Technology										
28. With the appropriate water technology, reclaimed water can be treated to drinking water standards										
29. The potential for technology failure presents too high a risk for reclaimed water use										
30. The technology to safely produce reclaimed water from wastewater does not exist yet.										
Power										
31. As things stand, building facilities managers have no say on where the water supplied to commercial buildings is sourced from.										
32. Decisions regarding reclaimed water use should be made by businesses and building owners, not facilities managers.										
33. Building facilities managers should be able to influence decisions around reclaimed water use in the buildings they manage.										

Acceptable uses										
34. My tenants would find the use of reclaimed water for non-contact uses acceptable (e.g. flushing toilets, gardening and air conditioning).										
35. Direct potable use is not acceptable to my tenants (i.e. adding reclaimed water to the drinking water distribution system).										
36. The use of reclaimed water for cleaning would be acceptable to my tenants (i.e. floors, bathrooms, and surfaces).										
Scale										
37. Reclaimed water use would be more effective if implemented at the municipality level rather than at building level.										
38. Small-scale reclaimed water treatment (i.e. per building) would be more effective than larger treatment plants at municipality level.										
Policy										
39. Reclaimed water use is not feasible because there is no national reclaimed water policy										
40. Reclaimed water use is not feasible because there is no local reclaimed water policy.										

Appendix B: Survey

1. What is your Gender
    1.1. Female
    1.2. Male
    1.3. Other
2. What is your Ethnicity
    2.1. White
    2.2. Indian
    2.3. African
    2.4. Asian
    2.5. Coloured
    2.6. Other
3. What is your Nationality?
4. Which province do you reside?
5. What is your level of schooling?
    5.1. No schooling
    5.2. Primary School
    5.3. High School
    5.4. Degree
    5.5. Postgraduate Degree
    5.6. Other
6. What is your job title?
7. Do you consider yourself to be a building facilities manager and if yes, how many years have you been a building facilities manager?
8. How many buildings do you manage?

9. The term reclaimed water means?
   9.1. Wastewater has been treated
   9.2. Wastewater that has been treated to drinkable quality
   9.3. Wastewater is treated to non-drinkable quality
   9.4. All of the above
   9.5. I do not know
10. The term wastewater in the treatment cycle means
   10.1 Water that is wasted, such as leaving a tap open
   10.2. Used water from any combination of home, business, or industrial activities, surface run off or storm water
   10.3. Water that runs into the ocean
   10.4. Rain water that is not harvested in tanks
   10.5. I do not know

Appendix C: Permission Letter

University of the Witwatersrand,
School of Human and Community Development,
Department of Psychology,
Umthombo Building, East Campus
Private Bag, 3
Wits, 2050
Johannesburg
South Africa

South African Facilities Managers Association
1st floor, Acacia building
The Avenues Office Park
Homestead Road
Rivonia

24 June 2020

Dear Sir/Madam,

Re: Permission to conduct research at SAFMA.

My name is Lucy Phiri. I am studying for a master's in organizational psychology in the school of Human and Community Development at the University of the Witwatersrand. I am seeking permission to do research at SAFMA.

I am conducting research on recycled water. I am looking to identify factors that may influence the perceptions and willingness to adopt recycled water use amongst building facilities managers. This will help the researcher in understanding what may contribute whether managers choose to introduce recycled water in their buildings or not. I chose SAFMA because it will enable me to have access to managers of small and large building facilities and it will be useful in being able to access the managers online.

I will invite individuals from your organization to participate in this study. I am looking for 30 to 40 building facilities managers, with at least 10 years of experience. If they agree, they will be sent a link that will allow them to access the study. They will be asked to sort Q-statements online, which will be made up of 60 Q-statements. Participants will need to set aside approximately 30 minutes for this exercise. They can do the study in their free time, there will be no need for them to complete the study during work hours.

Participants will be asked to give their written or verbal consent before the research begins. Their responses will be treated confidentially, and identities (their names and the name of the organization) will be anonymous unless otherwise expressly indicated. Individual privacy will be maintained in all published and written data resulting from the study.

The results will be communicated in a research report. The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study. All research data will be safely stored in a password protected file.

I therefore request permission in writing to conduct my research through organization. The permission letter should be on your organization's headed paper, signed and dated, and specifically referring to myself by name and the title of my study.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Lucy Phiri

Lucy Phiri
0764894543
1353955@students.wits.ac.za

Prof. Andrew Thatcher and Dr. Anita Etale
+27 11 717 4533, +27 11 717 6087
Andrew.Thatcher@wits.ac.za, Anita.Etale@wits.ac.za

Appendix D: Participant Information Sheet

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Dear Sir / Madam,

My name is Lucy Phiri and I am a master's student in Organizational Psychology at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating factors influencing perceptions and willingness to adopt reclaimed water use amongst building facilities managers under the supervision of Prof. Andrew Thatcher and Dr. Anita Etale. The aim of this research project is to find out the factors that may influence building facilities managers to adopt (or not) reclaimed water use in their building facilities.

As part of this project, I would like to invite you to take part in sorting Q-statements about reclaimed water online. This activity will and will take around 30 minutes.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or choose not to answer any question if you do not want to. Your responses will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you. The data collected from this research project will be stored in a password protected file and will be kept for five years. With your permission the data collected from this research project may be used by other researchers. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the

University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrec-medical.researchoffice@wits.ac.za

Yours sincerely,
Lucy Phiri

Researcher:
Lucy Phiri 1353955@students.wits.ac.za, +27 76 489 4543

Supervisor:
Prof Andrew Thatcher, Andrew.Thatcher@wits.ac.za, +27 11 717 4533
Dr Anita Etale, Anita.Etale@wits.ac.za, +27 11 717 6087

Appendix E: Ethics Form

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT ETHICS COMMITTEE
CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE:	**PROTOCOL NUMBER: MAORG/20/08**
PROJECT TITLE:	Factors influencing perceptions and willingness to adopt reclaimed water use amongst building facilities managers
INVESTIGATOR	Phiri Lucy (1353955)
SCHOOL/DEPARTMENT OF INVESTIGATOR	SHCD/Psychology
DATE CONSIDERED	12 July 2020
DECISION OF THE COMMITTEE	Approved unconditionally
RISK LEVEL	Minimal Risk
EXPIRY DATE	31 December 2022

ISSUE DATE OF CERTIFICATE 25 July 2020 **CHAIRPERSON** ____________
(Dr Colleen Bernstein)

cc: Prof. Andrew Thatcher (Supervisor)

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

____________ 17 . 08 . 2020
Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix F: Factor Arrays

Factor 1 array

-5	-4	-3	-2	-1	0	1	2	3	4	5
15	11	18	29	37	6	30	4	22	34	8
2	24	39	17	25	35	12	27	9	3	20
	16	10	38	26	31	14	33	1	13	
			23	19	21	40	7			
				36	32	28				
					5					

Factor 2 array

-5	-4	-3	-2	-1	0	1	2	3	4	5
40	22	32	10	26	1	23	9	6	28	7
14	2	37	38	33	5	4	12	8	30	17
	13	15	36	20	31	25	29	27	34	
			39	24	19	3	21			
				11	18	35				
					16					

Factor 3 array

-5	-4	-3	-2	-1	0	1	2	3	4	5
40	22	8	24	39	20	13	12	27	34	9
11	36	2	16	18	32	1	19	3	33	21
	15	14	10	7	38	37	28	29	35	
			5	23	25	4	6			
				31	26	30				
					17					

Factor 4 array

-5	-4	-3	-2	-1	0	1	2	3	4	5
11	7	2	29	12	10	34	28	35	4	22
24	16	38	37	5	8	21	3	9	33	26
	19	14	25	13	27	39	1	17	20	
			40	23	32	6	36			
				30	18	31				
					27					