

Assessment of the security and sustainability of water supply in Grahamstown

ABSTRACT

Water security and future sustainability is fast becoming the major concern for Grahamstown. Efforts to maintain adequate water supplies to the city of Grahamstown has been affected not only by the recurring droughts, but as a result of a combination of factors concerning abstraction, mismanagement of water resources as well as a lack of infrastructure to deal with water demands and supply. Not only is the water supply a concern, but the quality of the water supplied is important to its security as well. Questionnaires were administered to various households within Grahamstown to determine the efficiency of the Municipality to deliver water as well as the quality of the water supplied. The Water Services Act of 1997 was used as a basis to make comparisons with the reality of Makana's water situation and what is actually required. Interviews were conducted as support to this and the predictions made by the Water Services Development Plan for Makana was used as well. The results show that water supply is a growing issue within Grahamstown as a result of mismanaged infrastructure and treatment plants, a lack of adequate funding as well as poor quality water. It was also found that the relationship between water concerns and water conservation is very low within Grahamstown and thus water conservation efforts need to be promoted. Water availability in Grahamstown is of no great concern, however correct management is needed to maintain adequate supplies to households as well as improve infrastructure. The continued security of water depends on the efforts made by the local municipalities as well as the general public with regards to conservation and water sustainability.

Introduction

The "State of Environment Report" is a tool that helps combine and communicate information collected with respect to multiple environmental indicators (DEAT, 2007). The objectives of such a tool are to increase stakeholder understanding and knowledge of trends concerned with the state and trend of the environment. This also incorporates the stakeholder's understanding of consequences and causes with respect to the environment

(DEAT, 2007). The tool also provides a base on which to build better decision making at all levels. Overall the tool is designed to monitor and facilitate the measurement of progress towards sustainable development (DEAT, 2007). Such objectives can be achieved through understanding what is happening in the environment by identifying the environmental state and its trends. Reasons can then be formulated as to why these things are happening, and they are then broken up into either natural or human causes of environmental change (DEAT, 2007).

The future of the environmental also needs to be critically examined with regards to economic, ecological, health and social aspects of potential change, and therefore the implications associated with such change. Limiting factors also need to be identified, whilst opportunities need to be highlighted. State of Environment Reports are therefore regarded as a useful tool for the assessment and prioritisation of issues (DEAT, 2007). Recommendations can then be made towards planning and policy formulation. Such reporting consists of multiple cycles; whereupon updates of the State of Environment Reports can be used to access and monitor programmes which are already in existence (DEAT, 2007).

Water Security

Reddy (2002) states that water security is defined as a situation where people and communities have reliable access to water to meet their different needs. Such access to water is inclusive of both present and future needs. The water that they have access to must be both healthy and suitable for drinking purposes (Reddy, 2002). In short, water security is “some for all and forever”. Another definition of water security is given by Al-Otaibi and Abdel-Jawad (2007) as the availability of enough water so as to meet needs and wants in all sectors of consumption at all times. Water is the basic component for social, industrial and economic development, which means that long-term water plans to secure and conserve water for all sectors of demand need to be developed and implemented (Al-Otaibi & Abdel-Jawad, 2007). Where there is not enough fresh water, in countries such as Kuwait, water security is based on the availability of non-conventional water supplies and the use of treated wastewater with enough storage capacity to cover seasonal differences in availability and strategies in consumption (Al-Otaibi & Abdel-Jawad, 2007). As such, a number of facts pertaining to water security have been realised:

- It is crucial to rely on water reserves from within one’s own country.

- It is vital to secure abundant freshwater supplies so as to meet demand of all sectors whilst too build up a dependable water reserve.
- Those water storage facilities which are available are often expensive and insecure.

With reference to the above, water security can therefore be defined as the availability and security of suitable quantities of freshwater so as to meet normal and rational demand given an emergency situation (Al-Otaibi and Abdel-Jawad, 2007). It is therefore paramount to never underestimate the value of water security as it stabilises and ensures sustainable development of a country (Al-Otaibi and Abdel-Jawad, 2007).

Water Security as a Global Scale Issue

Water security is a worldwide issue as people around the globe suffer with limited access to running water, no safe drinking water, and water that carries diseases and harmful bacteria. In today's environment the world faces serious crises with regards to water management, with profound negative implications for food security, human health as well as the maintenance of aquatic ecosystems (Anon., 2007). Each year the global population grows by an astronomical 80 million people (Anon., 2007). If the current consumption rate of water continues as it is then by 2025 a total of 2.7 billion people of the world's population will suffer from chronic water shortages (Firsing, 2008). Although the world's population is increasing the world's fresh water supply is not doing the same.

Global water demand has risen at a rate of roughly 2.4 % per annum, with higher trends in developing countries due to increased water-intensive agricultural activities and urbanisation (Kamara & Sally, 2003). Today, 1.2 billion people living in developing countries do not have access to clean water (Kamara & Sally, 2003).

Firsing (2008) concluded that parts of the world, such as India, China, the cotton belt of Central Asia and swathes of the Middle East, are reaching the physical limits of their water supplies. Sub-Saharan Africa (the world's poorest economic region) is also experiencing major problems with regards to water, and this region currently lacks the finances to build dams and irrigation systems to get water to farms and homes in the rural areas where the majority of their population resides (Anon., 2007).

Today roughly 80% of the world's population lives in areas where fresh water supply is insecure (Black, 2010). Researchers today have also put together an index of 'water threats', within which scarcity and pollution are included. Roughly 3.4 billion people comprise the most serious threat category (Black, 2010). Western countries today often successfully conserve water via dams and reservoirs, which are beneficial for the people but not necessarily for our environment. Hence, researchers have urged developing countries not to conserve water in the same way due to the negative environmental impacts (Black, 2010). Instead researchers have encouraged governments to invest in water management strategies. These strategies combine infrastructure with the more 'natural' options, such as protecting floodplains, wetlands and watersheds (Black, 2010). As human populations grow and the climate changes, people are more likely to be found in more water stressed situations concerning supply in the coming decades (Black, 2010). One should then consider the idea as to how water is kept in the landscape without being in a manmade structure such as a dam. The concept is critical as it requires that landscape conditions to be carefully monitored and protected. A wetland can be an area that is dominated by dry land and gives rise to first order streams associated with the entire river profile (Whigham, 1999). One then begins to recognise that if areas such as these are converted into agricultural zones, the river system's source would be significantly affected. It is a similar process that occurs downstream, for if a dam is built, the water stagnates, which may cause negative impacts such as disease, or an increase in water temperature that diversely affects the natural ecology (Smith *et al.*, 2000; Connor, *et al.*, 2003; Reischel & Bjornn, 2003).

The survival of the environment, on which the human population so greatly depends, has its own requirements that need to be conserved. One of the most basic is the need for clean, untarnished water and therefore the management of natural springs, wetlands and ground water levels are methods of water conservation that allow for future planning as well keeping a clean and natural environment in which we live.

Water Security as an African Issue

In sub-Saharan Africa, inadequate agricultural production and high population growth often combine and increase the chance of water scarcity. It has also been projected that a number of countries in sub-Saharan Africa are to become physically water scarce by 2025, including South Africa (Kamara & Sally, 2003).

Due to lack of educated human capital, most African countries do not have unlimited access to the advanced technology and coordinating capacity needed to supply water, even if finances were readily available (Falkenmark & Lundqvist, 1998). In the developing world, major water related issues can consist of ground and surface water pollution resulting mainly from inefficient or inadequate waste water treatment, lack of infrastructure to take care of sanitation, contamination from agricultural fertilizers and pesticides, and primary and secondary salinization of ground water (Falkenmark & Lundqvist, 1998).

Water Security as a South African Issue

To combat such threats, South Africa has started to focus on restructuring and reforming its water sector, so as to rectify issues concerning inequality whilst promoting economic development and the alleviation of poverty (Kamara & Sally, 2003). This has also given rise to the need for developing and applying necessary research and planning techniques in support of decision making and policy. About two-thirds of South Africa today consists of an arid or semi-arid landscape, where the quantity and distribution of rainfall subjects large regions of the country to periodic extremes of floods and droughts (Kamara & Sally, 2003).

The National Water Act (NWA) hopes to provide solutions to this problem and emphasises that the process of water management should create opportunities for disadvantaged communities and individuals, whilst improving their socio-economic well-being (Kamara & Sally, 2003). The NWA also identifies ways in which this can be achieved through legally binding frameworks in which water resources are to be used, conserved, protected, developed, controlled and managed to the benefit all stakeholders (Kamara & Sally, 2003). It also seeks to balance efficient water use and aims to achieve equal water access, ranging from domestic users, smallholders, to agricultural producers (Falkenmark & Lundqvist, 1998). Thus the NWA prioritises the need for pro-poor strategies which emphasizes the principle of 'some for all' instead of 'all for some' (Kamara & Sally, 2003).

Per capita water availability in South Africa is forecast to become one of the lowest in the SADC region by 2025, where the current renewable freshwater resources are around 50 km³ (Kamara & Sally, 2003). Whilst the country's population is growing at an annual rate of about 2.4 % per annum, water availability declined at a rate of 10 % between 1995 and 2000, and at current levels is expected to decline 21 % by 2025 (Falkenmark & Lundqvist, 1998).

Thus the country's great dependence on surface water combined with the fairly unreliable rainfall patterns, has important implications for efficient water management in the future.

Today, irrigation compromises 60 % of the total water requirement within the country, which is justified by the large proportion of poor and vulnerable population groups on which they depend (Kamara & Sally, 2003).

A country is classified as physically water scarce if the degree of water resource development is larger than the proportion of potential water resources available for diversion (Kamara & Sally, 2003). Today, 70 % of the population has access to piped domestic water supply in South Africa (Kamara & Sally, 2003). Thus, the NWA faces a big challenge when both the number of people with access to domestic water and the per capita daily water consumption rates both increase. Per capita water availability is declining over time in South Africa, which makes the plan to secure suitable water resources given the growing demand increasingly challenging (Falkenmark & Lundqvist, 1998).

Water Security in the Eastern Cape - focusing on Grahamstown

Grahamstown is an extremely diverse city that was historically built in a segregated manner. The city of Grahamstown fully depicts the model of an apartheid city with different areas segregated by race (Donaldson, 2001).

Water is vital for human life, well-being and is considered a basic human right. So the idea that some underprivileged people are still living in areas without suitable water is unacceptable, but it is a reality. Grahamstown is a town that has and still happens to have housing issues. Many suburbs have grown in size and are still merging. Development is allowing for a general urban sprawl to be created (Donaldson, 2001). The Grahamstown area contains a large number of informal housing.

According to the local independent newspaper, The Grocott's Mail (2010), Grahamstown experienced a drought that was particularly severe in 2009 – 2010. This water shortage has resulted in dam's reaching levels too low to supply its industry or the residents with required quantities of water (Grocott's Mail, 2010). However, an area that was hard hit was that of the Vukani District (Donaldson, 2011). The Vukani community reached a point where they were only receiving water for about one hour a day (Donaldson, 2011). This was made worse by the fact that the communities allotted hour occurred in the middle of the night. A meeting was

held by The Movement for Unemployed People with a Rhodes University lecturer standing in as the chair. However, the local municipality members failed to attend (Water Rhapsody, 2010).

Makana Municipality –Grahamstown

A paper by Haigh, Fox and Davies-Coleman (2010) stresses the importance of local municipalities working towards Integrated Water Resource Management (IWRM) as an effective way to sustain the future water supply as well as ensuring water services are provided to all. The paper highlights that with an effective Water Service Development Plan (WSDP) Makana Municipality will be able to conserve, supply and keep up with the ever increasing demands for water supply (Haigh *et al.*, 2010). However, this could take a number of years as the processes are complex and there is an inadequate capacity of skills in the technical and administrative departments to meet water delivery potential (Haigh *et al.*, 2010).

Unfortunately, information from the Makana Municipality was unattainable due to the lack of responses by the Technical and Infrastructural management staff. Thus, papers regarding frameworks for local governments (Haigh *et al.*, 2010), the Water Services Act (WSA, 1997) and the 2007 WSDP (DWAF, 2007) for Makana Municipality were used as a basis to determine areas of ‘weakness’ within the municipality in relation to the results of questionnaires performed, highlight the municipality’s responsibilities as well as provide recommendations for future sustainability and conservation of water within the city of Grahamstown.

The Makana Municipality (along with all other local governments), is required to undergo four tasks (WSA, 1997), namely (according to Haigh *et al.*, 2010);

1. To effectively regulate water services by putting in place government policies and by-laws.
2. To ensure adequate prioritisation and implementation of water services in order to achieve cost-effectiveness and sustainable management overall.
3. To ensure correct day-to-day operations for sustainable provision of water to local populations.

4. Finally, to adopt a WSDP framework every 5 years and include all tasks and responsibilities of the Government with regards to water services, to be reviewed annually.

The Makana Municipality last drafted their WSDP in 2007 and another is to be expected in 2012. It is the WSDP 2007 annual review for the year 2010 that we were not able to attain. However, the WSDP for 2007 has five year predictions which we will consider.

Haigh *et al.* (2010) state that drafting a Water Services Development Plan (WSDP) is useful as it highlights problems and reveals gaps experienced in water service delivery and may thus be used to determine the level of compliance with the National standard for Water Services Act (1997). The WSDP report consist of 10 basic elements, (Haigh *et al.*, 2010), of which the socio-economic profiles of residents, the service delivery profile, the water resource profile, water consumption and demand management and water service infrastructure are particularly important in the context of Grahamstown.

- Socio-economic profiles of residents

The social aspects of the population are to be determined in order to understand the level of income and surrounding environment of the population, so that implementation of services is done in accordance with affordability and accessibility (Haigh *et al.*, 2010). Therefore, placing unsubsidised meter tariffs within areas of low-to-no income dwellers would be inappropriate.

- Service level profile

The services already in place are reviewed and new areas for service inputs are analysed (Haigh *et al.*, 2010). The level of services meeting the people is important to understand as it is one of the standards within the Water Services Act (1997). People should never be without a supply of water for more than seven days in any year (Haigh *et al.*, 2010). However, if this is the case, then it is the responsibility of the water institution to ensure 10 litres of water per person per day is supplied to the affected area (WSA, 1997). The consumer service profile is similar and looks at whether people are receiving the services they are entitled to (Haigh *et al.*, 2010). According to the WSA (1997), no person should have to walk further than 200 metres to obtain water.

- Resource profile

The water resource profile looks at the quantity of water available to Grahamstown (Haigh *et al.*, 2010). This refers to the amount of water received from the various dams. In the 2007 WSDP, the amount of water received by the various dams was: Glen Melville Dam- 900 Ml/yr, Settlers Dam 1861 Ml/yr, Howisons Dam 500 Ml/yr and Jamesons Dam 150 Ml/yr, giving a total of 3410 Ml per year for Grahamstown. The same levels apply for the year 2012 (Haigh *et al.*, 2010). The question now is whether this supply is sustainable and whether it meets the demands of a growing population (Haigh *et al.*, 2010).

- Water consumption and demand management

Water conservation is a growing concern in the Makana District as water restrictions associated by droughts are a frequent occurrence. The restrictions of 2009 and 2010 were only just lifted earlier this year. It is the Municipalities responsibility to educate the population on effective water conservation strategies as well as to implement targets for water conservation, such as metering all water use, keeping track of leaks and ensuring that there is no contamination of fresh water (Haigh *et al.*, 2010). It is also important to monitor the amount of raw water that is being used in agriculture and industries.

- Water service infrastructure

The Makana Municipality is known to have infrastructural issues with regards to water leaks and old unreliable pumps. The infrastructure is expensive and the Makana Municipality is unable to afford replacements without Government assistance, which in itself is a lengthy process to obtain.

Future Trends in Water Supply and Municipal Goals.

According to the Makana Municipality's WSDP, the districts population is predicted to increase at an annual rate of 1.1 % (WSDP, 2007). Thus, from the year 2007 where the Grahamstown population was 132 504 it is expected to rise to 139 791 in the year 2012 (WSDP, 2007). Thus, it is stated in the WSDP (2007) that future demands 'target market' on water will remain fairly constant. However, there will still be a great need for increased levels of service and infrastructure as the demands for water require holistic methods of water conservation from repairing leaks and expanding flow capacity to reduce pipe bursts and

educating the population (WSSP, 2007). Most importantly it is highlighted in the WSDP (2007) for Makana to reduce the water demand for new consumers, appropriate levels of service be allocated to each community, such as the use of payment meters and efficient plumbing fittings (WSDP, 2007).

The GEO – DPSIR (Drivers, Pressures, States, Impacts and Responses) Framework

The GEO-4 conceptual framework is a model (see figure 1) that was developed during the fourth Global Environmental Outlook convention and is a conceptual model that places sustainable development at its core (UNEP, 2004). The model aims to analyse the relationships between human society and the environment. The examination occurs across a temporal scale allowing for a continued assessment to occur and long term monitoring to be put in place (UNEP, 2004) The GEO-4 conceptual model is broken up into five key components, these are; Drivers, Pressures, States, Impacts, Responses and Impacts.

- Drivers

The drivers are considered as fundamental processors within a system that ‘drive’ it towards a change(s) (UNEP, 2004). A drought and subsequent heavy rainfall experienced in Grahamstown might drive actions around water supply and demand. It is a driver towards change in water availability and supply to residences.

- Pressures

The pressure component of the framework is based solely on activities that result in environmental change, thus factors such as population growth in Grahamstown, increased water needs and thereby the need for dams being built and boreholes being drilled are all pressures that lead to increased impacts on water sustainability.

- States and trends

This component is based solely on the state and trend of natural conditions found within the environment. It is vital to monitor these conditions as they are very often susceptible to change (UNEP, 2004). The status of water with regards to availability and quality will change as a result of salt leaching, mismanagement and poor conservation efforts.

- Impacts

This particular component relates solely upon the effects that environmental pressures cause. It is a measure of change, be it to human well being, social or economical (UNEP, 2004). All changes are considered to be of equal importance as they are all interlinked (UNEP, 2004). Insufficient water availability and supply, poor quality and polluted water, may impact the well being of residents, farmers and reserves alike. Crops production is reduced, gardens are not watered and aquatic species are at risk.

- Responses

Responses are the methods that societies have implemented in order to counter the negative effects and bolster the positive effects of impacts. These responses include legislation, regulations, laws and projects (UNEP, 2004). With particular concern with water sustainability and security, the National Water Services Act has been enforced. Similarly at the local scale a Water Services Development Plan for Grahamstown was been drawn up, including various water conservation measures in place, infrastructural replacements and extensions that are being considered.

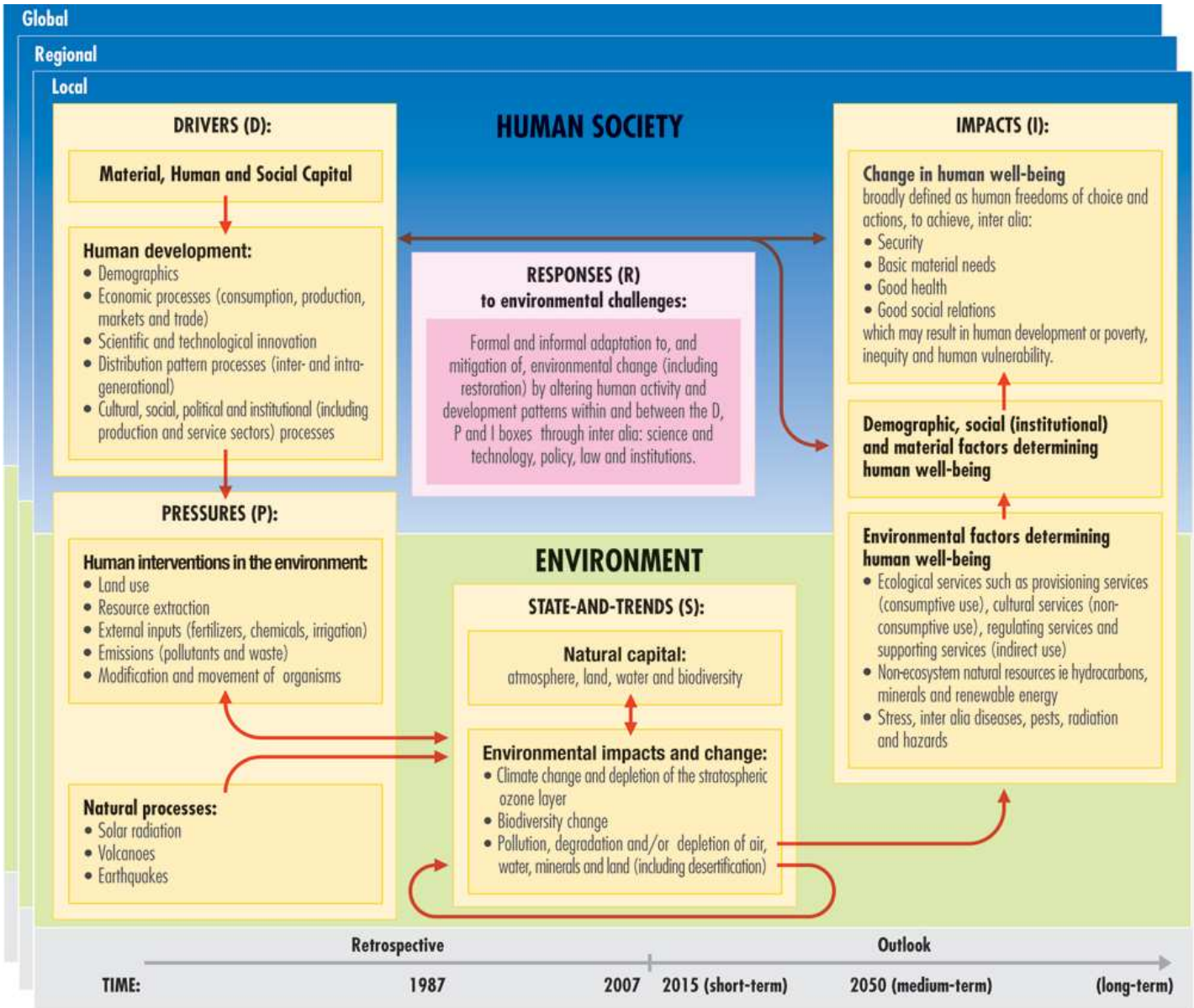


Figure 1: The GEO-4 Conceptual Framework
(UNEP, 2010)

Objectives and Aims

The aim of this study is to assess the status and trend of water supply, and its sustainability in respect of the city of Grahamstown.

The objectives of this study that need to be achieved are to determine:

- ❖ How people living in different parts of the city perceive water security and sustainability.
- ❖ How people living in different parts of Grahamstown obtain their water supply.
- ❖ The link between people's individual concerns for future water supply and their personal extent of water conservation.
- ❖ Conservation strategies for Grahamstown homesteads and how to improve recycling techniques.
- ❖ The infrastructural capacity to deliver water to Grahamstown residents.

Methodology

Study Area - Grahamstown's Water Supply and History

Grahamstown or Rhini (Xhosa name) is situated in the Eastern Cape of South Africa and is part of the semi-arid succulent Karoo (Southern, African Places, 2003). Grahamstown is a small city situated approximately 130 km east of Port Elizabeth and 180 km west of East London. Grahamstown receives an average of 450-500 mm of rain per year, most of which in the winter months, with average daily maximum temperatures that range from 18.9°C in July to 26.8°C in February (Southern, African Places, 2003). The region is coldest in July with an average night time temperature of 5.6°C. It lies in the Makana Municipality located between latitude 33°17' south 26°31' east. Grahamstown has an altitude of roughly 535 metres above sea level. The city's population is roughly 125, 000 people and is mostly Xhosa, English and Afrikaans communities (Southern, African Places, 2003). A large part of Grahamstown's population is due to the six to seven thousand students at Rhodes University as well as the several large boarding schools in Grahamstown.

Grahamstown was established in 1812 as a military post and thus became an important urban centre. British settler groups were predominantly located within Grahamstown and as a result in the mid-1800's the city was the second largest settlement after Cape Town (Dullabh, 1994). However, due to mineral discoveries inland, the population decreased as did the city's economy (Dullabh, 1994). The city centre is defined by the Cathedral, the Drosty Barracks and currently Rhodes University campus. In 1855, the African population was forced to move and live on the eastern side of the town, and the whites on the west (Dullabh, 1994). During Apartheid, planning within Grahamstown was racially controlled in terms of places of residence as well as access to certain services (Dullabh, 1994). In 1970, the township was removed to make way for a separate black local township which was called Rhini (Dullabh, 1994). This saw a lot of changes spatially with regards to the development of informal housing and squatter homes (Dullabh, 1994). The unification of Grahamstown and Rhini was the first step in an attempt to redefine Grahamstown as a non-racial city with equal opportunities. However, like any other city it still contains contrasts of race in both social and economic situations (South African Places, 2003). There are still large townships within Grahamstown. Tantji, Hlalani Villa, Joza location, Sun City informal, Eluxolweni and Fingo are a few seen in figure 2.

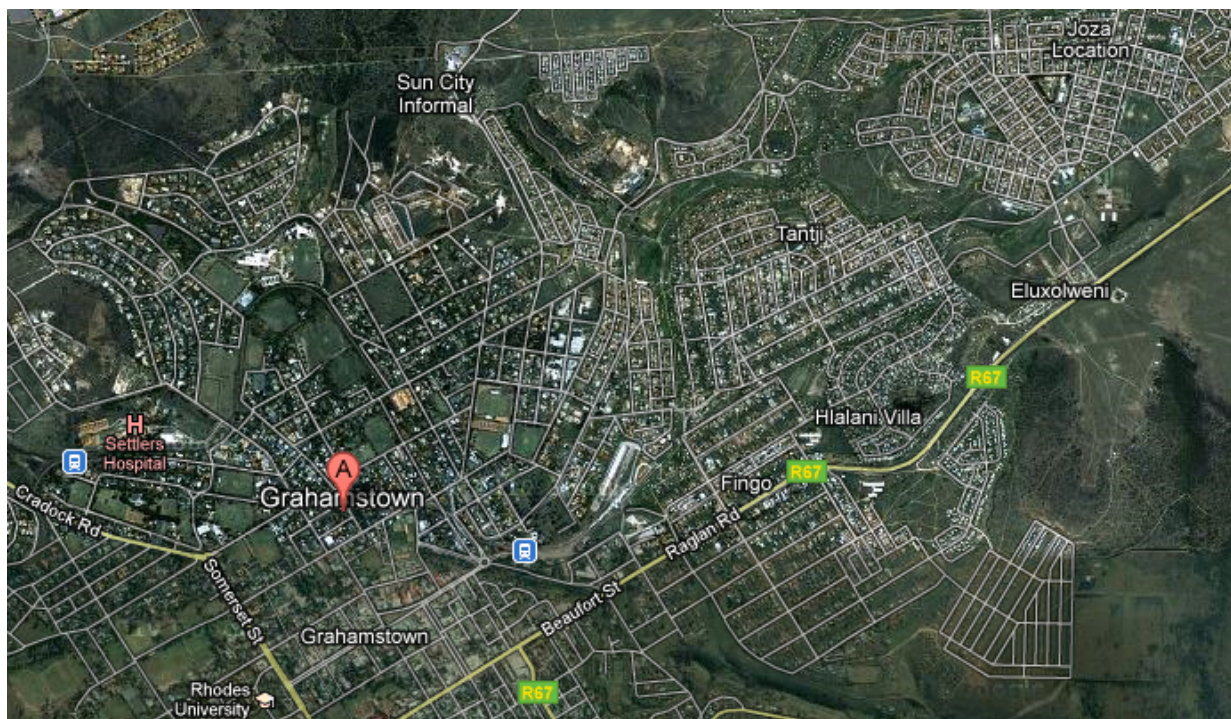


Figure 2: The city of Grahamstown where the study was conducted

Grahamstown has always struggled to obtain a viable water supply that has kept up with the growing population. Efforts to resolve future water supplies led to the raising of the Settlers Dam wall in 1981, by 2.3 meters (Haigh *et al.*, 2008). In 1992 the Glen Melville Dam was completed and the Orange-Fish inter-basin transfer scheme now runs into it supplying the dam with 6 mega-litres of added water (Haigh *et al.*, 2008). Since then further water provision services have progressed, resulting in a majority of households 76.5 % having access to running water, 16.5 % were served by community stands and 2.5 % from tanks and boreholes, 2.9 % from vendors and a further 1.6 % of the population rely on natural resources (Haigh *et al.*, 2008).

With regards to our study on water security, the catchment area for Grahamstown's water sources is of importance, as are the surrounding dams and reservoirs from which Grahamstown extracts its water, those being the Slaaikraal, Howison's Poort Dam and Settlers Dam (Haigh *et al.*, 2008). Water from the previously mentioned dams is pumped into two reservoirs which are then gravity fed to the treatment works. The water then has aluminium sulphate added and is then left to settle (Haigh *et al.*, 2008). The treated and settled water is then sent to four reservoirs that supply Grahamstown with water. However, the infrastructure is old and the pumps are fragile and thus lead to interruptions in effective water supply (Haigh *et al.*, 2008).

Data Collection

Data Collection

- Household Questionnaires

120 questionnaires were administered to households across Grahamstown; 30 in low to middle income areas, 30 in middle to high income areas, 30 students living in digs and 30 to students currently living in Rhodes University Residences. The houses were randomly selected using a 1:10 000 Orthophoto map of Grahamstown and by randomly choosing positions on the map and selecting the nearest home to this point (see appendix one for orthophoto). Appendix 1 also contains the questionnaire administered to the above mentioned target areas. The questions administered were related to the objectives whereby information regarding; perceptions of water quality, how individuals obtain their water, the distances

required to travel to obtain this water, the amount spent on water as well as the individuals personal attempts for water conservation was asked.

- Interviews

Various interviews were conducted to obtain additional information relating to our objectives. An interview with the water business ‘Oasis’ was conducted and information regarding their concerns on the quality of water was gained, as well as their methods of purifying water and their views on the increasing sales of bottled water.

An interview with the Head of Technical Services for Makana Municipality, regarding the infrastructural capacity to deliver water to Grahamstown residents, was unfortunately unable to take place. Nikki Kóhly, Secretary of the Kowie Catchment Campaign, who is greatly involved in water related issues within Grahamstown, was interviewed and her knowledge and answers included in the results.

- Research

Research formed a major part of our project and aided us in many aspects with regards to water policies, acts as well as the requirements for Makana Municipality water services. The Makana Municipality’s website was consulted (however information obtained from here was minimal). The Water Services Development Plan (2007) for Makana Municipality was consulted and provided information regarding five year predictions the Municipality had concerning Grahamstown’s water supply, catchment capacity, population growth and many other aspects. The National Water Services Act (1997) was also consulted and used to relate the current water situation in Grahamstown to the required state for all towns in South Africa.

Data Analysis

The data from the questionnaires was analysed and both qualitative and quantitative data was reviewed. Information pertaining to individual perceptions on future water security and sustainability within Grahamstown was used as qualitative data to support (or reject) statements and information made by the Makana municipality in WSDP reports and other water service related documents. Statements made by organisations such as the Kowie Catchment Campaign as well as the Internal Water Resource Management (IWR) was supported by the perceptions and information gained from the questionnaires.

Different source areas where people obtain their water were graphed in order to determine the difference in water quality and service levels. For example; the percentage of people who obtain water from tapped sources within a home and the percentage of people who travel outside their home to obtain water. These graphs were then compared to the 2007 WSDP report of Makana municipality as well as to the Water Service Act (no.108 of 1997).

Information obtained regarding the infrastructural capacity to deliver water to Grahamstown residents was assessed according to; the current population of Grahamstown, the predictions of future population, and therefore how population levels will affect the level of infrastructure needed to sustain water supply, as well as the effective management of water services. Cost of new infrastructure was assessed in relation to profits gained by local governments for water services and whether it is feasible without National Government support.

The 2007 WSDP report was used to determine the quantity of water being used by each sector (public, commercial and industrial) and the level of service being provided to them. This was then analysed to determine whether the quantity being allocated to each sector is equitable and that the water supply remains sustainable.

The questionnaires devised included questions pertaining to people's concerns for future water supply as well as their efforts to recycle and conserve their water. Graphs were then constructed to assess the links between their concerns and their personal conservation and recycling methods in order to determine a relationship between complaints and efforts to conserve water.

Assumptions

We assumed that:

- People or institutions were honest in their answers.
- That we would get feedback from institutions and Municipalities regarding questions raised and interviews requested.
- That our sample size was an adequate representation of Grahamstown residents

Pitfalls

- A few questionnaires were incomplete and/or filled out incorrectly.

- People and institutions declined our request for interviews or failed to respond completely.
- Time constraints hindered us from acquiring information from surrounding farms and reserves regarding water abstraction and boreholes.
- We received a lack of information with regards to infrastructural capacity of water services in Grahamstown.

Ethical Considerations

The Rhodes University ethics policy was consulted and adhered to. Thus, all respondents from the questionnaires and interviews were informed that the questionnaires and/or interviews were entirely voluntary and they could discontinue at any moment. Respondents of the questionnaires were also informed that any information they revealed would remain entirely anonymous and be kept strictly confidential.

Results

Water cuts appeared to have been experienced in all residential types but are mostly evident in the informal settlements within Grahamstown (Figure 3). A total of 67 % of individuals from informal settlements that completed the questionnaire experienced water cuts, whereas only 10 % of students experienced water cuts. Students that stay in Rhodes University residences seem to have better water security than people in the informal settlement or the permanent residents of Grahamstown. The water security of those in the informal settlement is much lower than other residential types.

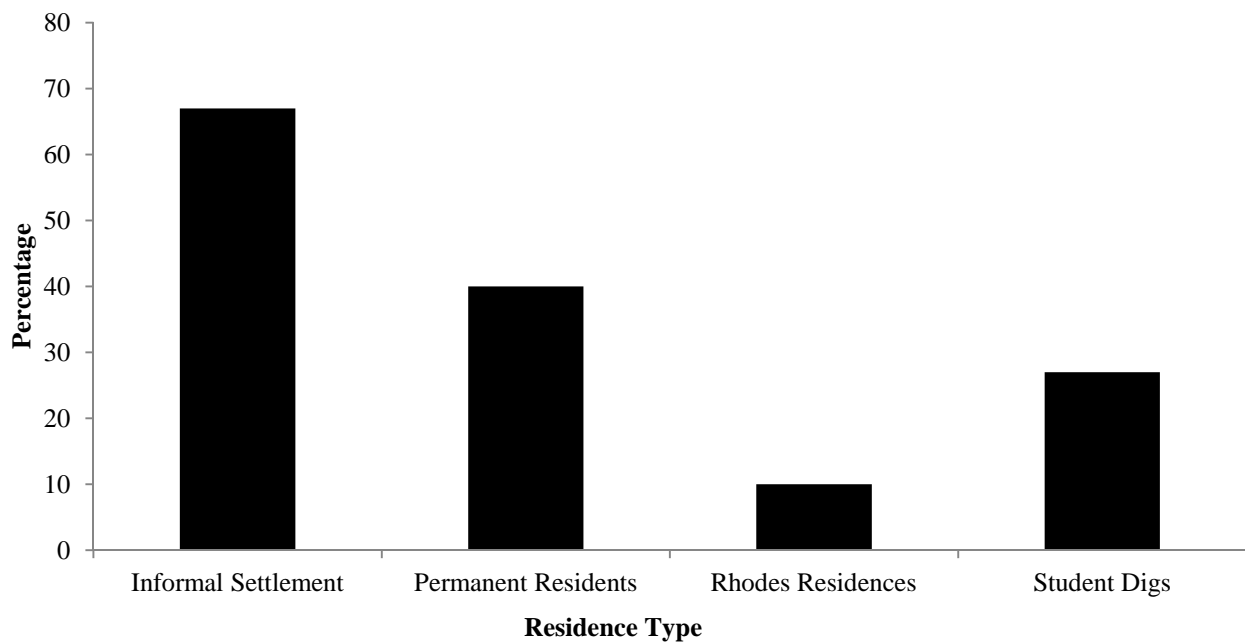


Figure 2: Frequency percentage of residences that experience water cuts by various residence types within Grahamstown (n=120)

A permanent resident of Cradock Heights stated that due to the affected suburb being high up they found that water cuts were more frequent and they were badly affected. They therefore found it necessary to install water tanks to capture rain water. Many residents of the Vukani District (informal settlement) stated that water cuts were a weekly occurrence and once the fire brigade had to supply water for the community. A resident of the Hlalani District (see Figure 1 or orthophoto in appendix) explained that the community did not get water on weekends. In general, most respondents of the informal settlements experienced water cuts on a weekly basis.

A total of 62 % of people interviewed rated the quality of water supplied by the municipality a rating of poor or very poor (Figure 4). Only 15 % of respondents gave a rating of good or very good in respect of the Grahamstown Municipal water. A total 23 % of respondents rated the water quality as adequate.

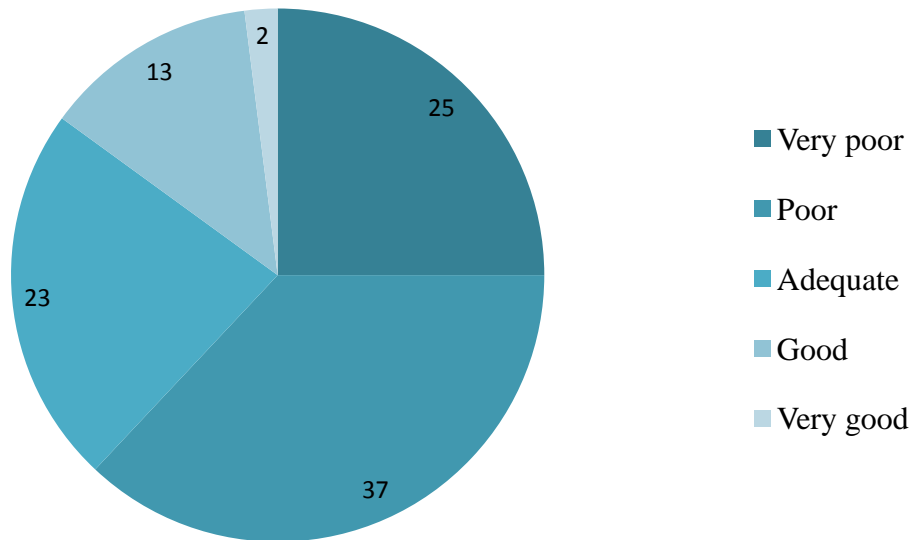


Figure 3: The resident's perception of Municipal water quality in Grahamstown (n = 120)

Respondents describe the municipal water as; “bad tasting and smelling”, “unhealthy”, “shocking quality”, “milky/brown/dirty colour”, “unsafe for drinking” and “unable to drink”.

It was found that 33 % of people interviewed relied solely on water supplied by the municipality while 67 % rely on water obtained by alternative sources. These sources include; shop bought, spring, borehole and rainwater and these sources are shown in Figure 5. A resident of Cradock Heights stated in the questionnaire that the household used municipal water but only after it has been boiled and purified.

Results gained from the questionnaires led us to assume that informal settlements relied on rainwater and did not purchase water from shops (this is assumed due to a limited income). Bottled water seems to be a source well utilized by Rhodes students (those in digs and residences) and by permanent residents in Grahamstown and seemed by far the most common source of water used. Borehole water was the least used source of water with a total of only three respondents utilizing this source. Permanent residents who used rain water had tanks on their property (one respondent had two tanks that were capable of storing 1000 litres each).

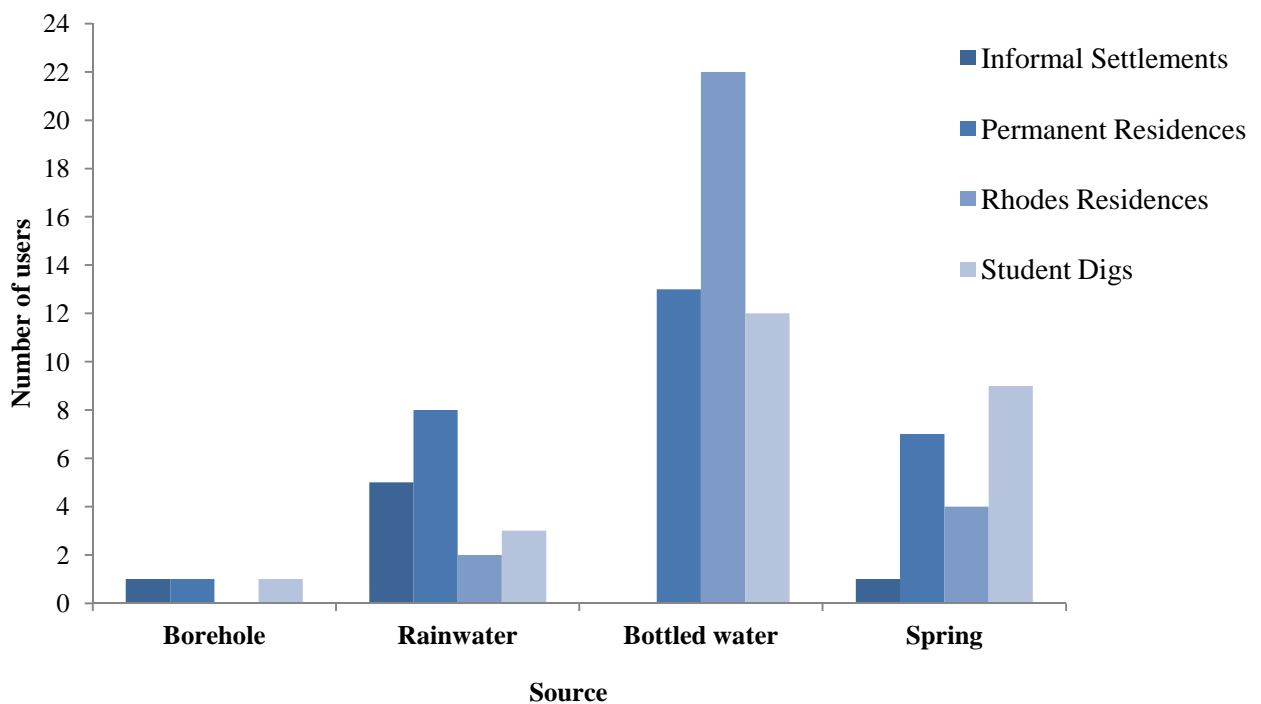


Figure 5: Alternative sources of water and the number of users

Oasis Water (a store in Peppergrove Mall that sells bottled water – with 130 outlets nationwide) sells approximately 50 – 60 000 litres of water per month, mostly to students. Oasis utilizes water from the municipality and cleans it with advanced purification processes which include sand filtration, carbon filtration, element filtration, reverse osmosis, UV treatment and ozonation. The manager also stated that the municipality claimed that there is no need for Oasis water. Oasis explained that the total dissolved solids (TDS) in the Grahamstown ranges from between 350 to 400 g/l but after their cleaning it decreases to 6 g/l. The safest TDS range is between 0 and 10.

Permanent residents, students in Rhodes University residences and students in digs have access to water within the house or in the immediate vicinity. However, only 47 % of people living in informal settlements have this luxury. Of residents in these townships, 10 % have to walk distances of greater than 1 km in order to obtain water and 7 % of them walk distances of between 100 m to 1 km.

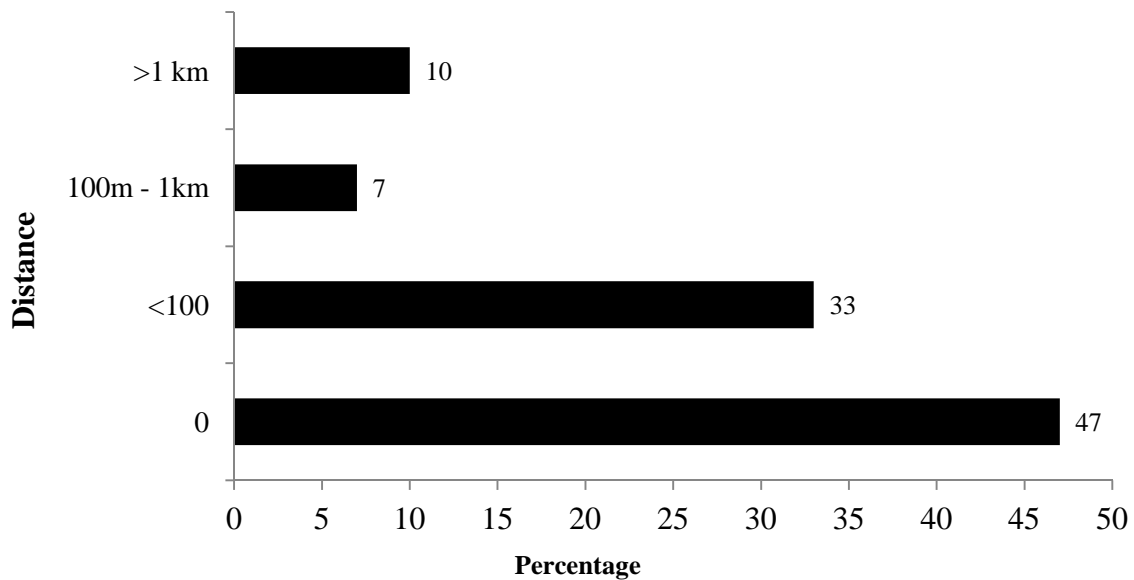


Figure 6: The distance residents in the informal settlements travel to get water (n = 30)

Large proportions (85 %) of respondents do not recycle their water (Figure 7 below). Some respondents, especially those in Rhodes residences, said that they did not know how to recycle their water. However, it is interesting to note that 84% of respondents said that future water supplies were a concern for them. Those that said they were not concerned said that it was “because they were leaving South Africa after their studies” or “[I] only drink shop bought water”.

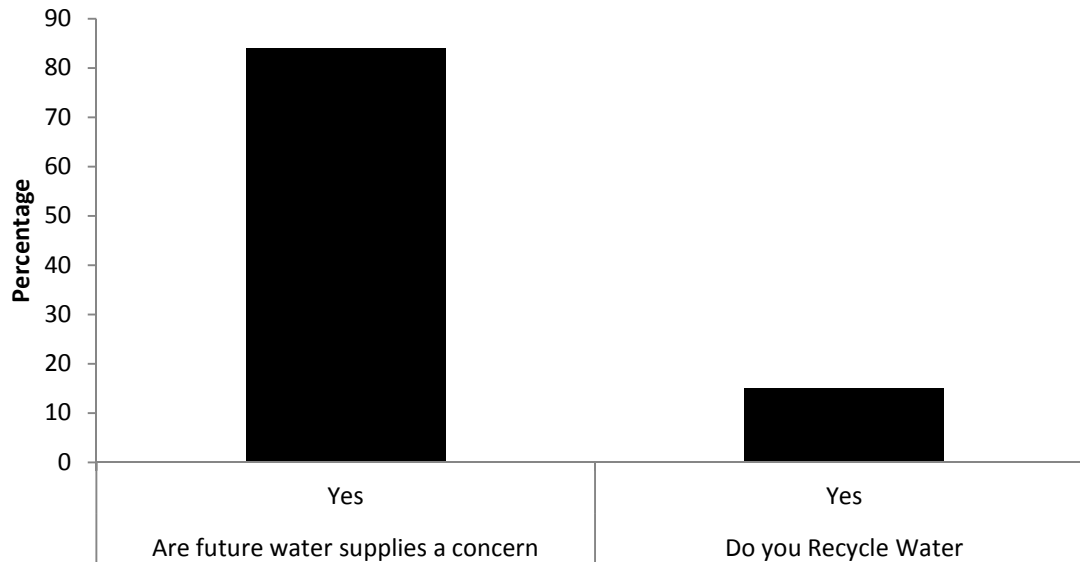


Figure 7: The percentage of respondents who conserve water and those who are concerned about future water supplies (n = 120)

Interview

Interview conducted with Nikki Kóhly (Secretary to the KCC) in regards to water security within the Grahamstown area (28/09/2011):

The Kowie Catchment Campaign has been following Grahamstown's water situation very closely, reporting misdemeanours, leaks as well as helping the Makana Municipality with water conservation efforts. However, according to Mrs Kóhly there is still a lot of work that needs to be done. Most importantly, says Kóhly, the training of Municipal staff dealing with water at the two treatment works in Grahamstown. Kóhly states that the lack of training of staff could be as a result of the shift between old and new staff, which undermines skills, experience as well as work ethic. Thus 'possibly' affecting maintenance standards as well as incorrect alfosphate doses in the treatment plants (which occurred recently in Grahamstown). Kóhly also mentions that DBSA (Development Bank of South Africa) intends to increase the pipeline capacity, however this is ironic as the water supply is at full capacity and thus increasing the infrastructural pipelines would serve little purpose. It would

be money better spent if the current infrastructure was replaced and maintained instead says Kóhly. One of the risks mentioned in the KCC meeting for June 2011 was that an Eddy Norton, a consultant for the Makana Municipality, is the only qualified person who knows how to handle the water pumps at the various dams. If anything were to become of Mr. Norton or if he were to retire, Grahamstown would face the issue of unqualified persons trying to ‘manage’ our water infrastructure, which could have adverse affects on Grahamstown’s water supply comments Kóhly (as already occurred when Settlers Dam was accidentally emptied due to the outlet being incorrectly handled).

Kóhly also highlights the importance of augmenting Grahamstown’s water supply with the alternative to dams, rainwater and other sources in order to keep up with the water demands of a growing population.

When asked about the quality of water, Kóhly stated that this was one of the pressing issues within Grahamstown and one which the public are most concerned about. Water quality tests are ideally required every three days, but in Grahamstown are done only once a month by ‘Blue Drop’, a Municipal Status Testing company.

We asked Kóhly to comment on the Municipality’s efforts for water conservation and their efforts in creating water conservation awareness to Grahamstown’s public; she said that the KCC has been helping the Municipality with regards to conservation, however much more is needed to create awareness across all sectors of Grahamstown. Kóhly feels that the people’s attitudes need to be geared to water conservation as many people are lazy and do not want to inconvenience themselves. As a result the KCC and the Municipality have had many discussions regarding stepped tariffs for water users, so that greater water users pay increased prices for water quantities exceeding the ‘norm’. This could perhaps increase water conservation efforts as well as maintain a sustainable supply of water for future use. Other water conservation awareness methods by the Municipality have included pamphlets (although designed by the KCC) and Billboards. Kóhly states that further efforts have been ‘slow’ as she feels there is a lack of incentive in the department and that authorities fear the pressure of decision making.

Discussion

How people living in different parts of Grahamstown obtain their water supply

About 37 % of the respondents in Grahamstown obtain their water from the municipality, whilst the other 63 % obtain their water from various other sources. These water sources include borehole, rain, bottled and spring water. The results all refer to potable-water, and therefore reflect the source of drinking water. The results show that bottled water is by far the greatest source of alternative water, whereas borehole water is the least popular source. Rhodes residences rely heavily on shop-bought water and this is so because the majority of respondents from the Rhodes residences were highly concerned about the quality of the water being supplied and felt it was unhealthy to drink. Thus, they prefer drinking shop-bought water, which is made possible by their increased spending power. The informal settlement however, relies most on the free municipality water, as they do not have the spending power to satisfy their own preferences and therefore choices. Therefore they cannot afford shop-bought water, whereby the only other affordable option is rainwater. About 53 % of respondents from the informal settlement did not have easily accessible water, so had to travel varied distances to get it. These water collection points were often at established sites, such as a communal tap. For that matter and according to the United Nations (2010), the average African woman has to walk an average of six kilometres to collect water, which may take up to six hours per day. In this regard, the water supply in the informal settlement of Grahamstown is relatively well off, yet the situation is still inadequate as all individuals deserve the right to easily accessible water. The provision of water by the Makana Municipality has shown to be inconsistent as illustrated by the results and by the fact that many of the town's citizens seek alternative water sources. As such a paper by Haigh *et al*, (2010), stresses the importance of the local municipality working towards Integrated Water Resource Management (IWRM) as an effective way to sustain the future water supply, as well as ensuring water services are provided to all.

How people living in different parts of the city perceive water security and sustainability

Concerns around water security are increasing globally, yet it has still not been theorised (Warner, 2004). There has also been much discussion as to what 'water security' entails. The concept of 'water security' has branched out both horizontally and vertically (Warner, 2004). Horizontal branching refers to issue areas, whereas vertical branching refers to the levels of

water security (Warner, 2004). Today it is important that society overcomes the Westphalia paradigm, which gives priority to diplomatic relations and military security (high politics) over issues of development concerning environmental and economic problems (low politics) (Warner, 2004). Hence, it is important to focus on the latter from a South African perspective in order to tackle the concept of 'water security and sustainability'. Therefore, there needs to be a shift from high politics, where most of the best decision makers lie, to low politics concerning the environment (Warner, 2004).

Of all the residence types, the informal settlement had the greatest number of water cuts, but student digs and Rhodes residences found that they experienced the least number of water cuts. When looking at the results, 25 % of the respondents found the water to be of very poor quality. Added to that, 62 % of the respondents rated the water quality to be below adequate. These figures give a clear indication of the negative perceptions residents of Grahamstown take toward the quality of water they receive from the municipality. This therefore also indicates that there is a problem with the supply and quality of water which the residents of Grahamstown receive. However, on a more global scale and between the years 1990 and 2008, approximately 723 million people in rural areas and 1.1 billion people in urban areas gained access to a better drinking water source (United Nations, 2007). This shows that authorities have been tackling the issue of water security, and suggests that water security can be achieved (United Nations, 2007).

Overall, respondents from all residence types said that they had experienced some form of water shortage or cuts, yet the frequency of these cuts was rare. This shows that the real problem with the water supply in Grahamstown, according to the public, is rather concerned more with the quality of the water than its supply. That being said, and with reference to the results, the informal settlement seems to be worst off of all the residence types as the respondents found water cuts to be frequent. In this case water supply is an issue for the residents of the informal settlements, whereby literature has often emphasised that informal settlements are known to have a limited supply of good quality water (Weldegebriel, 2011). This then raises the question as to why the municipality has not been allocating water fairly across the residence types. In relation to this, there seems to be a gap between the supply of water and the actual amount of water supplied to each residence type. Reasons for this may be explained by the fact that the water in the informal settlement is freely supplied by the municipality, meaning that its' supply does not have to be guaranteed. Also, the residence

types other than the informal settlement have some form of monetary value placed on their water supply. People earning less of an income were also more concerned for future water supplies than those who had a greater income. In economic terms this explains the more stable supply of water to these wealthier regions, as the cost of the water is directly placed on the consumer. Overall, South Africa has started to focus on restructuring and reforming its water sector, so as to rectify issues concerning inequality whilst promoting economic development and alleviating poverty (Kamara and Sally, 2003). The National Water Act hopes to provide solutions to this problem and emphasises that the process of water management should create opportunities for disadvantaged communities and individuals, whilst improving their socio-economic well being (Kamara and Sally, 2003).

The infrastructural capacity to deliver water to Grahamstown residents

According to Makana's Municipality Water Service Development Plan (WSDP), the population is predicted to increase at an annual rate of 1.1% per annum, which suggests that future demands of water should remain fairly constant (WSDP, 2007). However, the dams in which Grahamstown gets its water from seem to be under threat from siltation, but this will only be a threat in years to come (KCC, 2011). The water pumps at the Waainek Water Treatment Works broke at the beginning of 2011 and there were numerous areas around Grahamstown that were badly affected by the water cut offs which lasted several days. The threat of this must be avoided in the future, as it could have negative effects, especially during periods of high water demand such as the Grahamstown Festival. Climate change is also a probable factor concerning the security of Grahamstown's water in the future, but is not of high importance at this date. Today, the Makana Municipality faces many challenges whereby much of its water related infrastructure needs to be replaced and further training; capacity and purification measures need to be addressed. When looking at a more global perspective, a cost-benefit analysis was undertaken by the World Health Organisation which showed that for every US\$1 invested in improved drinking water and related services, the economic benefits range between US\$4 and US\$34 depending on the region (United Nations, 2010). Thus, the Grahamstown municipality should use this as a positive scenario of actually investing in the town, in order to produce long-term benefits for all.

The link between people's individual concerns for future water supply and their personal extent of water conservation.

About 85 % of respondents said they did not recycle water. Such a result shows the poor extent to which water is perceived as a limited resource, and also that water-security issues are not of individual concern. However, on the other hand 84 % of the respondents did say they were concerned about future water supplies. These figures give strong evidence of the research-implementation gap; a missing link between the actions and knowledge of scientists and the requirements of managers and policy and decision makers. On a global scale today, it would be safe to say that most people are concerned about the future of the planet, particularly with reference to climatic conditions. Most individuals understand that climate change and global warming are real issues of today, yet they often brush aside the difficulties and lifestyle change required with these issues. As the results show, this case is classically represented between those who recycle water and those who believe future water supplies will be a concern. Overall individuals do not recycle the water because it ‘takes effort’ and is costly (United States Environmental Protection Agency, 2011). Individuals would however, be more inclined to recycle water if there were convenient systems in place which allowed them to carry on with their day to day lives as usual. Many countries today find this task of ‘implementation’ most difficult, especially as the economic, political and social environment is dynamic and changing. Water recycling is therefore a vital component in the successful management of water resources. This is so because through water recycling and conservation, communities can still have sustainable development and a strong economy whilst too more importantly meet the environmental needs (United States Environmental Protection Agency, 2011).

Conservation strategies for Grahamstown individuals and how to recycling techniques

When water is stored for too long without movement, it increases the risk of contamination to the water, whilst without damming or any other storage methods, the immediate supply of water to areas of need would not be available (Smith *et al.*, 2000). If this is to be the case, then society would be hard struck whenever drought conditions hits the region for long periods of time. Therefore, in order to conserve ones limited water resources, one should take as many steps as possible to recycle the valuable resource. Therefore, whilst performing our data collection, we purposefully developed a few specific questions studying the recycling habits of the Grahamstown.

As can be expected, most of the results indicate a poor level of recycling, which is a major cause for concern. When probed further, the resultant answers were generally linked to an

uncertainty as to how to recycle. The essence of this response tended to come down to the basic nature of human insecurity; as people generally wanted to recycle, but were unsure as to how it can be performed without completely changing one's lifestyle; and thus no water recycling occurred.

We therefore took steps in order to help the general populace understand a few basic methods of recycling. In order to express the significance of recycling with proof as to its importance, we located an institution to which all locals would be familiar and observed their methods of basic recycling first hand. The concept behind this was to observe large scale recycling methods implemented by Rhodes University and to then be able to use these observed methods as a building block, to ensure successful recycling methods that may be made public knowledge and hopefully become common place practices.

In this way, we noted that with a campus as large as the one belonging to Rhodes University, coupled with the current campus population size, conservation of water resources is evidently more important than ever (Grocott's Mail, 2010). Rhodes currently advocates the removal of alien plant species, the use of water saving devices and the re-use of grey water amongst other activities (Rhodes University, 2011). This being said the university could still pursue a much greener approach to water use and conservation.

New university residences and buildings will include the installation of low-flush toilets, auto-cut-off taps, and the fitting of extra water storage tanks. The University Grounds and Gardens also advocate the use of indigenous hardy plants such as aloes and euphorbia as a means of reducing irrigation costs (Rhodes University, 2011). Irrigation is principally sourced by borehole water and is limited to areas of concern such as sports fields and gardens under development (Rhodes University, 2011).

Some residences have employed the use of their house committees in improving environmental awareness. Other organisations include societies such as GRASS, Common Ground and Galela Amanzi. These student-run societies can have an instrumental influence for water campaigns; an example of the bottom-up approach. Such initiatives should be encouraged. Campaigns should be awareness-based for example; encouraging water saving activities such as low-flow showers, not washing cars, avoiding leaving taps running, only do a full load of washing at a time and encouragement to report municipal leaks. In such a multi-

cultural society, such as it is at Rhodes University, these practises may not be a norm and therefore by advertising them correctly, may become more accepted and more widely used.

The university encourages students to re-use grey water and to harvest rainwater (Rhodes University, 2011). There is, however, little infrastructure in place to assist with this. Simply providing piping or buckets and purchasing rain tanks for students to collect grey water (for irrigation) and rainwater (for consumption), respectively is one way of improving conservation practises.

Leaking toilets and pipes can contribute to the wastage of more than 1000 litres of water per month, per pipe (Rhodes University, 2011). Equating such waste into cost, means by the saving of 1000 litres of water is equivalent to saving \pm R16. Much like the government advocates energy-saving practises to money-saving practises; the University can implement a rewards program to maintenance and management to improve upkeep.

People by nature will always take the easier route. If conservation is to flourish it must be the obligatory path. Should the University make certain conservation practises not only mandatory, but easier to perform; then the conservation of water would become a promising possibility. It would appear that a seemingly obliged populace may be the key to creating a populace that is conservative of the water to which they so greatly require.

Conclusion

Many people within Grahamstown are constantly concerned about the supply of water and future demands. While conducting questionnaires throughout the town, it was evident that there is a growing concern for the supply of water to the community and 84 % of the people involved in the survey indicated that they are concerned for future supplies. In the KCC minutes held in June (2011), there were several issues that were brought up, which regard the supply of water to the people of Grahamstown. One issue was related to a burst pipe that was continuously leaking and was proposed to be closed instead of being fixed. Another issue included a case where by valves in the Jameson Dam leaked an in turn leaving a near empty dam. This issue could be avoided by proper management and repairing of the valves in the dam (KCC, 2011).

As stated previously the Water Services Act (1997) declares that individuals should never be without a supply of water for more than seven days in any year. From the results gained from

the questionnaires we learned that there were multiple areas within Grahamstown that had severe water cuts that extended a 24 hour period. According to the WSA (1997), no person should have to walk further than 200 metres to obtain their water, however, from our results we see that 17% of the lower income population surveyed had to walk further than the specified 200 metres. The conservation of water is a major issue in Grahamstown and individuals need to make a greater effort to conserve this valuable resource.

It is therefore vital that a general consensus about the recycling of water become both apparent as well as the norm, as not only will this help to promote a better lifestyle, but it will guarantee the sustainability of water as a resource for years to come; and as we all require water in order to survive, it is a sustainable future to which we all need to strive to achieve.