Cape Peninsula University of Technology

# MANAGEMENT OF WATER SHORTAGES IN A SELECTED MUNICIPALITY IN THE EDEN DISTRICT, SOUTH AFRICA

**by**

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## DECLARATION

I, Wesley James Baatjies, declare that the contents of this mini-thesis represent my own unaided work, and that the dissertation/thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

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## ABSTRACT

The focus of the study is the Eden District, George municipal area, Western Cape Province, South Africa, which was severely affected by the worst ever drought in 132 years from 2009-2011 (Bamford, 2009). The reduced rainfall impacted negatively on urban water supplies for the area. In 2009 the Member of the Executive Committee (MEC) for Local Government in the province requested that George Municipality draw up specific measures to be implemented when water resources (in dams and rivers) dropped to certain levels. Plans for possible future drought situations, periods of low rainfall, or insufficient raw water resources, have been done put in place for the needs of the residents of the focus area.

The research problem of this study encompasses the assessment of the interventions put in place to address the shortage of water, particularly the implementation thereof, and the strategies and mitigations that contributed to the alleviation of the water shortage. The core objective of the research was to investigate the implementation of the water interventions (water restrictions) authorised to address the water shortages in George, in November 2009.

This study employed a qualitative research approach where in-depth interviews were conducted with purposely selected individuals employed in the George Municipality Civil Engineering Services Department, and its Water Services and Disaster Department sections as they could provide first-hand information on the measures implemented to alleviate the problem and on the water shortage status.

The research findings indicate that many short-term strategies provided a substantial reduction in overall water usage. The implementation of the strategies and mitigation measures were useful to the various departments in the George Municipality in tangible ways to help manage the water shortages.

George Municipality should continue to market water restriction awareness to the public even though the George is no longer experiencing water shortages. The Municipality should adapt to deal with longer and more frequent periods of water shortages. Available tools (e.g. drought policy and by-laws) should be revised and adapted to establish appropriate measures under changing conditions.

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# CHAPTER ONE
# INTRODUCTION

## 1.1 Introduction

George Municipality is one of the seven local municipalities comprising the Eden District Municipality (EDM) of the Western Cape Province, South Africa. In 2009-11 the Eden district suffered a devastating drought.

This study looks at the adequacy of the water resources estimates and the implementation the measures to address and alleviate the water scarcity.

## 1.2 Background

Section 27 (b) of the *Constitution of the Republic of South Africa, Act No.108 of 1996* (South Africa, 1996) states that water is a basic need that must be provided to all citizens, and that this is the obligation of government. According to the Constitution, water must be free from contamination and pollution, and people must have access to clean and good quality water.

The EDM is one of five district municipalities in the Western Cape and covers the Kannaland, Langeberg, Mossel Bay, George, Oudtshoorn, Plettenberg Bay and Knysna local municipalities (South Africa. Western Cape Government, 2013).

The purpose of the EDM is to administer and make rules for a district, which includes all local municipalities in the district. The district municipality and local municipalities share responsibility for local government in their area. This ensures that all communities, particularly disadvantaged communities, have equal access to resources and services, for example water, electricity and sanitation. The district municipality will help those local municipalities that do not have the capacity to administer their local municipality or to provide services to their communities, with finances, facilities, staff or knowledge (South Africa. Western Cape Government, 2013).

The Eden district is situated along the “Garden Route” of the Western Cape Province. It is sandwiched between the Outeniqua and Tsitsikama mountains and the Indian Ocean,

extending from Mossel Bay in the west to the Storms River in the east. Major towns along the route are Mossel Bay, George, Knysna and Plettenberg Bay. The Garden Route is well known for its fruit and vegetation, and a variety of ecosystems as reflected in the high density of provincial and national parks in the area. Other attractions include its scenic and diverse coastline, lakes and river mouths (at Wilderness and Knysna), the Outeniqua Mountains near George, the indigenous forest, and fynbos (Stevens, 2005).

The town of George is very centrally situated, halfway between Cape Town and Port Elizabeth, and is the centre of the Garden Route. It is located on a ten-kilometre plateau between the Outeniqua Mountains to the north and the Indian Ocean to the south. George is rated among the most popular tourist attractions in South Africa and is popular among both local and overseas visitors for its scenery and moderate climate (Nell, 2003).

The town also has a sophisticated infrastructure with banks, conference facilities, businesses, major shopping chains, transport and shopping facilities, yet it retains an atmosphere of peace and tranquillity. It is a major accommodation centre, with an array of facilities at different prices to suit different tastes and needs. It has a pleasant climate, conducive to horticulture and agriculture. Botanists and zoologists have discovered a high diversity of forest and fynbos (Nell, 2003).

George is 1,068km² in extent (George Municipality, 2011). It is structured in 25 wards and includes:

- The city of George.
- The villages of Wilderness and Herolds Bay.
- Various coastal resorts such as Kleinkrantz, Victoria Bay and Wilderness National Park.
- Rural areas such as Rondevlei (east of Wilderness), Geelhoutboom, Herolds Bay, Hansmoeskraal and Waboomskraal.

The first inter-governmental relations disaster meeting, initiated by the Eden District and Provincial Disaster Management Centres when the level of the GRD had dropped to 33 per

cent, was held in August 2009. Delegates included representatives from the Eden District, Provincial Disaster Management Centre, the provincial Departments of Water Affairs and Agriculture, and the Provincial and National Treasuries (George Municipality, 2010). The purpose of the meeting was to assess the situation and decide on the way forward. It was determined that without intervention from the role players, George's raw water supply would be depleted by February 2010 if the poor rainfall forecasts were realised.

One outcome of the meeting was that in September the MEC for Local Government sent a notice to the George Executive Mayor requesting immediate action to alleviate the drought conditions (Basson & Mooiman, 2010). The steps envisaged were to:

- implement emergency tariffs (subject to legal and procedural prescripts);
- commit human and financial resources needed to address the crisis;
- monitor consumers with high water consumption and take appropriate steps to limit their water use;
- commit financial and human resources to the Joint District Communications Team (a district-wide public awareness campaign);
- reprioritise operational budgets regarding law enforcement, public awareness, and flow control;
- reprioritise capital budgets to apply short- and medium-term solutions; and
- install low-flow or low-pressure water systems.

On receipt of the Minister's request, George Municipality imposed further water restriction interventions and contingency plans, including

- convening a special council meeting to inform politicians and rally political support;
- appointing a service provider to launch an intensive public awareness drive;
- appointing an engineering technician to monitor water consumption, identify high consumers, and to implement remedial actions where required;
- appraising municipal departmental heads of the situation and requesting reprioritised capital and operational budgets (with political approval);
- applying to the National Treasury to implement emergency water tariffs;
- Launching the Eden Awareness Campaign – a co-ordinated drought awareness programme; and
- applying for disaster funding to both the National and Provincial treasuries.

On 4 November 2009, Mr Anton Bredell, Member of the Executive Council (MEC) for Local Government in the Western Cape Province, requested that George Municipality draw up specific measures to be implemented when water resources (of dams and rivers) drop to certain levels, and plans for possible future drought situations, periods of low rainfall, or insufficient raw water resources, to address the needs of the residents of George.

On 20 November 2009, George Municipality was declared a drought disaster area (South Africa. Western Cape Government, 2009), in terms of the *Disaster Management Act No. 55 of 2002* (South Africa, 2002), because it was the worst affected of all the municipalities in the Eden District. In terms of the Act, the national, provincial and municipal Disaster Management Centres consulted together and came to this resolution.

## 1.3 Problem Statement

The Eden district experienced a natural climatological drought from 2009–2011. The compromised water conditions resulted in almost immediate negative effects for urban areas. Also, reduced rainfall resulted in numerous consequences to ground and surface water resources that translated into critically low urban water supplies in the district, specifically in George, which necessitated significant emergency responses (George Municipality, 2010).

The water shortages started in January 2009 as a result of low rainfall. After a dry and hot summer peak holiday season, and no rain relief, the capacity of the Garden Route Dam (GRD) had dropped to 60 per cent. The GRD is fed by the Swart River via a pumping scheme on the Kaaimans River that discharges water into the dam. It is the only source of water for the George municipal area, including Herolds Bay and Victoria Bay. In peak times the GRD supplements the water supply to Wilderness, which has the Touws River as its main source of raw water (Basson & Mooiman, 2010).

In April 2009, George Municipality introduced water restrictions. Initially the water restrictions had little impact on water consumption; nevertheless they were intensified in June 2009

when the GRD dropped to a level of 45 per cent. Rainfall was minimal, and the raw water source was under increasing stress while consumption remained high.

The research problem encompasses the assessment of the shortage of water and the strategies and inventions set in place, in November 2009, to alleviate the water shortage. The particular focus of the study was on the implementation of the strategies as tentative discussions with senior managers revealed that they lacked an understanding of how to implement the proposed strategies

## 1.4 Research Objectives

The core objective of this study was to investigate the implementation of the water restriction measures set in place to counteract the water shortages in George in November 2009. Further, this study analysed the effectiveness of these measures. A lack of sufficient water could lead to health and economic collapse with a resultant social impact.

The measures were therefore analysed to examine the performance of the mitigation strategies to counteract the water shortages in George.

## 1.5 Research Questions

a) What were the effects of the water shortages from 2009 to 2011 on residents and other water consumers in George?
b) What was the progress of the Government's inventions to assist water consumers in George with the challenges involved in implementing water restrictions?
c) What were the existing water shortage alleviation strategies and measures in George from 2009 to 2011, and what was the current *status quo?*
d) What was the performance of the imposed measures?

## 1.6 Significance of the Study

This study will contribute to information on the measures implemented to counteract water shortages in George. It will help to raise water consumers' awareness of water-conservation measures and the importance of using water wisely. The study should increase the Municipality's vigilance in respect of future droughts.

The study served as a working document to policy makers in the water sector and can be useful to other Eden District local municipalities in making informed decisions related to water supplies in future, as well as to other district and local municipalities in the Western Cape Province. It determined the role of water consumers and how they could play a pivotal role in the preservation and sustainability of water supplies.

## 1.7 Preliminary Literature Review

A review of literature is aimed at contributing a clearer understanding of the nature and meaning of the problem that has been identified. In a general sense, a literature review serves to put the researcher's efforts into perspective, situating the topic in a larger knowledge pool (De Vos, Strydom, Fouché & Delport, 2005).

The researcher embarked on a theoretical and legislative overview of the Eden District, George municipal area, the challenges of water shortages encountered, and the measures implemented to counteract the water shortages.

The researcher consulted newspapers, journals, the Internet, books, and diverse relevant documents, and liaised with the Municipality by means of telephone and email.

The library website of the Cape Peninsula University of Technology (CPUT) (library catalogue: Primo by Ex Libris) was consulted and Google Scholar was used to research this topic. The search was restricted to literature published from 2000 to date, with the exception of the *Constitution of the Republic of South Africa, Act No. 108 of 1996* (South Africa, 1996). Key words, titles and phrases used to conduct the search for articles and books included: drought; water shortages; George Municipality; *Government Gazette*; Western Cape Government; drought in the Western Cape; water shortages in the Western Cape, Eden District Municipality and Eden District; drought in the Eden District; and water shortages in George.

While there is a paucity of literature available on water shortages in George, what was available was found in annual reports, the service delivery budget implementation plan

(SDBIP), minutes of meetings, reports, documents, circulars, journals, diverse policy documents and the *Government Gazette*. These were useful when ascertaining areas of research on the origins of the water shortages.

## 1.8 Research Methodology

This study used a qualitative research approach. The researcher explained and justified the use of the qualitative research approach in this study. According to Welman, Kruger and Mitchell (2005), the qualitative research approach considers and explains the logic behind research methods and techniques.

A qualitative research approach was more suitable for fulfilling the purpose of this research, because the interviews included an analysis of the measures implemented to alleviate the water shortages in George. A study of these measures indicated their performance, and the results can be used as best practice in the greater Eden District. By using a qualitative approach, it was possible to understand perceptions and opinions regarding the measures.

## 1.9 Data Analysis

The researcher adhered to the principles of content analysis when analysing the data. The researcher analysed both content and context of documents, reports and interviews of the themes identified. The researcher focused on the way the themes were treated or presented, and the frequency of their occurrence.

Content analysis is a special application of systematic observation of personal documents and mass media material. This may also deal with open-ended questions and the contents of in-depth interviews. This involves the content of these sources being examined systematically to record the relative incidence (frequency) of themes and the way in which these themes are portrayed (Welman, Kruger & Mitchell, 2005).

A more detailed examination of the measures implemented to counteract the water shortages in George, was addressed.

## 1.10 Ethical Considerations

Any research study raises ethical considerations. However, the in-depth, unstructured nature of qualitative research, and the fact that it raises issues that are not always anticipated, means that ethical considerations have a particular resonance in qualitative research studies (Ritchie & Lewis, 2003).

The researcher respected the rights of participants and institutions, according to the following criteria:

1. Informed consent: The researcher adhered to the precept of the right to informed consent in this study when exploring the perceptions and opinions of the participants and respondents.
2. Anonymity and confidentiality: The proposed conditions for anonymity and confidentiality were addressed, and made very clear to participants. The researcher emphasised that all information provided was strictly anonymous and confidential. Participants and respondents were allowed to share personal information to the extent they wished.
3. Protection from harm and discomfort: The researcher ensured that respondents and participants were not exposed to discomfort and harm.
4. Fair treatment: The researcher ensured that participants and respondents were selected fairly during the study.
5. Rights of institutions: The rights of institutions were safeguarded by the researcher obtaining permission from the relevant authorities.

## 1.11 Organisation of the Study

The chapter outline and structure is as follows:

**Chapter One: Introduction**

This chapter addressed the research background, which entails an introduction, statement of the problem and rationale for the study. The research objectives, research questions, significance of the study, literature review, research methodology, data collection, data analysis, ethical considerations and definitions of concepts were briefly outlined.

**Chapter Two: Literature Review**

Chapter Two contains a review of literature related to the challenges of water shortages and measures implemented to alleviate water shortages. It looks at water, global and local water resources and issues, climate change, and literature on drought management. The literature review provides a theoretical and legislative overview of the available literature at national, provincial, and, particularly, at municipal level.

**Chapter Three: Research Methodology**

In Chapter Three the research methodology used in the research is presented. It demarcates the area of the study and the methods used. The researcher used the qualitative method and analysis of in-depth interview.

**Chapter Four: Data Analysis and Results**

This chapter analyses the research data. It presents the research findings and is accompanied by interpretations of the water crisis and interventions for this investigation. An analysis of the measures implemented to alleviate the water shortages is addressed in this chapter.

**Chapter Five: Discussion, Conclusions and Recommendations**

This study concludes in Chapter Five, which proposes conclusions and recommendations based on the findings of the study.

# CHAPTER TWO
# LITERATURE REVIEW

## 2.1 Introduction

This chapter presents an overview of the George Municipality, as the study is located within this area. Evidence of water shortage in this location will be explored together with literature pertinent to the study of water shortages. A theoretical overview of water will also be presented in the literature overview.

## 2.2 Water

Water literally surrounds us on the Earth. It is in the air we breathe, as an invisible vapour and in tiny liquid droplets. Water as a liquid fills streams, bayous, rivers, wetlands, groundwater aquifers and vast oceans. It is stored in the soil beneath our feet (Pennington & Cech, 2010).

Water is an essential part of the ecosystem, a natural resource, a social and economic good, whose quantity and quality determine the nature of its utilisation.

In Southern Africa it is a limiting resource for development and a change in water supply could have major implications in most sectors of the economy, especially in the agricultural sector. Factors that contribute to vulnerability in water systems in Southern Africa include seasonal and inter-annual variations in rainfall, which are amplified by high run-off production and evaporation rates (Schulze & Perks, 2000).

## 2.3 Global Water

Since the beginning of human settlement on Earth, water has been used for drinking, sanitation and irrigation purposes. In pre-historic times, humans usually settled in areas of reliable water supply. During times of drought clans of humans were often forced to relocate to survive. Prior to human intervention, the world's water supply remained in a natural state (Sipes, 2010).

Floods and droughts were common in many regions of the pre-historic world. Natural global warming and cooling varied the Earth's climate, causing life in the various ecosystems to

evolve, adapt, or disappear. As human population increased, the need for food supplies steadily grew (Pennington & Cech, 2010).

Between 1940 and 2000, withdrawal of fresh water has increased more than fourfold, despite improvement in water efficiency. Yet in developing countries the provision of water services still lags far behind water needs. Even though many people in the world still lack basic water services, water scarcity has increased in many parts of the world. With the supply of fresh water limited by the dynamics of hydrological cycles, per capita water availability declines as population grows. Increased contamination by population has further reduced supply of fresh water and increased the cost of treatment of available supplies (Lange & Hassan, 2006).

Human use of water is believed to have remained relatively unchanged for millions of years. However, in the past 100 years, global water use has increased at a rate more than twice the Earth's population growth, and has caused chronic water supply problems. By 2025, it is estimated that 800 million people will live in regions of severe water scarcity. Today, most countries in the Near East and North Africa, as well as Mexico, Pakistan, South Africa, and many parts of China and India are suffering from serious water shortages (Sipes, 2010).

According to Pennington and Cech (2010) drinking water is the most basic human use for water. Humans can survive eight to ten days without food, but only two days without water. Water must be safe to drink since poor-quality drinking water can lead to infectious disease. Unsafe drinking water is a daily problem faced by nearly two billion people around the world.

Water is a basic natural resource, indispensable for life. Although not priced, the value of rain is undisputed. Income and food for millions of people are directly dependent on the availability of fresh water (Sipes, 2010).

### 2.3.1 Distribution of water on Earth

Water is found everywhere on Earth, and is the only substance that can naturally occur as a liquid, solid or gas. The Earth contains approximately 1.39 billion cubic kilometres (331 million cubic miles) of water, with 96.5 per cent stored in the oceans. Approximately 1.7 per cent is stored in glaciers, permanent snow, sea, ice and polar ice caps, while 1.7 per cent

exists as ground water, and in rivers, lakes wetlands, and the soil. The remaining 0.1 per cent is contained in the Earth's atmosphere (Pennington & Cech, 2010).

### 2.3.2 Oceans

Salt water covers over 70 per cent of the Earth's surface, but is unequally distributed (Sipes, 2010). The oceans are saline, and are composed of about 3.5 per cent dissolved salts by weight. Human tolerance for salt is less than 2 per cent, which makes seawater undrinkable. Most agricultural crops are not salt tolerant and most industrial processes cannot use salt water. This has important implications for humans and ecosystems since nearly 97 per cent of Earth's water is salty, difficult, expensive or impossible to utilise for drinking water, agriculture and industrial uses (Pennington & Cech, 2010).

### 2.3.3 Fresh water

Fresh water is naturally rare, which may, at first glance, seem surprising. Fresh water comprises some three per cent of the total, and a large proportion of this is unavailable for use because it is frozen in ice caps and glaciers or locked away as soil moisture. Approximately 0.36 per cent is in underground aquifers, and about the same amount makes up lakes and rivers (Feldman, 2012).

Globally, fresh water is not evenly distributed across the continents, and varies season to season and year to year. Approximately two-thirds of the population, around four billion people, live in locations that receive only one-fourth of the world's annual precipitation. In addition, much of this precipitation is seasonal, for example mountain snow or monsoon rains (Sipes, 2010). Therefore water scarcity has developed as one of the most critical global risks.

### 2.3.4 Water shortages, scarcity and stress

As governments struggle to provide basic water services while global water scarcity increases, tough decisions about water allocations and infrastructure development will have to be made. Most countries are poorly equipped to anticipate and adapt to the economic consequences of increasing water scarcity because they lack sufficient information about water use and resources (Lange & Hassan, 2006).

Water is a valuable global resource and everyone should help look after it by using it carefully and wasting less. Some countries have high rainfall and large stores of water in the form of rivers and lakes. Others have few water stores, or irregular rainfall, and in hot climates water suppliers dry up quickly (Hunter, 2010).

A sufficient quantity of clean water is the prerequisite to good health and without it humans become susceptible to a surprisingly wide range of diseases and health-related problems. Access to adequate and safe drinking water should be a basic human right, yet today there are people globally who do not have access to sufficient safe drinking water. Many of these are managing on as little as five litres a day for all their drinking, washing and cooking needs (Watkins, 2006).

According to Hunter (2010) most plants and animals are composed mainly of water and no living thing can survive without it. Since water is essential to life, it should be a basic human right. However, despite many international agreements over human rights, the rights to fresh water have largely been ignored, perhaps because the scale of the problem is so enormous.

Drinking water quality, especially in terms of pathogens (that can produce disease or illness), cannot be isolated from sanitation, specifically the lack of adequate sanitation facilities. Various health problems created by the lack of access to clean drinking water and proper sanitation have a daily impact on 50 per cent of the population of development countries. The minimum requirement for water has been estimated as 502 litres for drinking, 20 litres for sanitation, 15 litres for bathing and 10 litres for food preparation (Gray, 2008).

Water scarcity is becoming one of the most critical risks threatening social and economic development throughout the world. South Africa is currently classified as a ‘water stressed’ country. This is largely due to climatic conditions in combination with human settlement patterns. South Africa is characterised by relatively low annual average rainfall combined with high evaporation rates (Watkins, 2006).

Stress is an imbalance between available supplies within various regions on the one hand, and demands on those supplies by multiple users on the other hand. Most commonly linked to population growth, extreme drought and inadequately maintained or deteriorating

infrastructure, the causes of stress include a combination of demographics, climate and economics. Understanding stress is vitally important for discerning the localised pressure of climate change, mass migration and agricultural production (Feldman, 2012).

Scarcity of water is widely perceived as the key feature undermining water security. Water security has been defined as “the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks” (Grey & Sadoff, 2007).

However, the notion of scarcity is both a skewed and limited view of water security. It is skewed in the sense that what mostly passes as water scarcity, are policy-induced consequences of mismanagement, while it is limited because physical availability is only one dimension of water security (Watkins, 2006).

One arena where water stress is most vivid is in so-called “megacities’’ which are urban areas composed of tens of millions of people. Cities are likely to see more conflict over fresh water supplies in the future. They are also touchstones for innovations in conservation, waste water re-use and recycling and desalination (Feldman, 2012).

Desalination can be considered as an alternative for solving a given set of fresh water demand problems. It becomes a real alternative when fresh water is an expensive local commodity due to the cost of making it available or due to market competition when it is scarce. Other water sources that are also capital intensive include long water transfers, the reclamation of sewage water and even deep aquifer development in extreme situations (Custodio, 2006).

Access to water is imperative to a successful development strategy, because access to clean water is one of the most significant resources for reducing poverty and disease, improving the life of the poor through rural development and for increasing food security (Reid & Vogel 2006).

One of the major concerns in achieving this goal has been the slow delivery of water access to poor and remotely located people. This issue has often been confused with the notion of water scarcity.

### 2.3.5 Groundwater

Groundwater is water stored under the Earth's surfaces; it represents about 30 per cent of the total fresh water supply, with the remaining 70 per cent in polar ice caps, sea ice, permanent snow, glaciers, lakes, rivers, wetlands and in the atmosphere (Pennington & Cech, 2010).

The total volume of groundwater on Earth is small, but is 35 times greater that the volume of water in all the fresh water lakes and flowing rivers of the world. The quality of world's groundwater ranges from extremely salty particularly in some coastal areas, to relatively mineral-free groundwater in Iceland. This makes groundwater unsuitable for some uses, especially drinking water (Pennington & Cech, 2010).

About 33 per cent of the Earth's groundwater is found in the Asian continents, 23 per cent in Africa, 18 per cent in North America, 13 per cent in North America, 6 per cent in Europe, 5 per cent in Australia and the remaining 2 per cent in other locations of the world (Pennington & Cech, 2010).

Groundwater is typically a poorly-understood source of water as compared to easily seen lakes and rivers. Groundwater can be collected or concentrated in a variety of ways. Water beneath the surface is called an aquifer. It is often thought of as a distinct 'pool' of water, but it is not always so. An aquifer is simply water found in soil, porous rock, or sand. It can be found in very small spaces and the properties of the soil or rocks that characterise the aquifer determine a great deal about the extraction possibilities (Shaw, 2005).

Groundwater depletion is increasing on all continents and many countries rely increasingly on international water sources, creating a potential for conflict over water in the future. In addition, the scientific community expects climate change to have a major impact on the hydrological cycle, in ways that cannot be predicted at this time (Lange & Hassan, 2006)

Economically groundwater is much cheaper than surface water, as it is available at the point of demand at relatively little cost and it does not require the construction of reservoirs or long pipelines. It is usually of good quality, usually free from suspended solids and, except in limited areas where it has been affected by population, free from bacteria and other pathogens. Therefore it does not require extensive treatment before use. Groundwater contributes substantially to the base flow of many lowland rivers, so any steps taken to protect the quality of groundwater will also indirectly protect surface water (Gray, 2008).

Over the years it has been discovered that groundwater and surface water are fundamentally interconnected and are integral components of the hydrological cycle. They have to be thought of as one cohesive system (Sipes, 2010).

### 2.3.6 Rivers, streams, lakes and wetlands

Surface water is a general term describing any water body that is found flowing or standing on the surface, such as streams, rivers, ponds, lakes and reservoirs. Surface water originates from a combination of sources: (1) surface runoffs: rainfall that has fallen onto the surrounding land and that flows directly over the surface into the water body; (2) direct precipitation: rainfall that falls directly into the water body; (3) interflow: excess soil moisture that is constantly draining into the water body; and (4) water table discharge: where there is an aquifer below the water body and the water table is high enough, the water will discharge directly from the aquifer into the water body (Gray, 2008).

According to Sipes (2010), water resources involve surface water, water below ground, and water that falls from the sky. Most cities meet their needs for water by withdrawing it from the nearest river, lake, reservoir, or aquifer. The quality and quantity of surface water depends on a combination of climatic and geological factors. The recent pattern of rainfall, for example, is less important in enclosed water bodies such as lakes and reservoirs where water is collected over a long period and stored, whereas in rivers and streams where the water is in dynamic state of constant movement, the volume of water is dependent on the preceding weather conditions.

In rivers the discharge rate is generally greater in winter than in summer due to a greater amount and long duration of rainfall. Short fluctuations in discharge rate, however, are more dependent on the geology of the catchment. Some catchments yield much higher percentages of the rainfall as stream flow than others. Even a small reduction in the average rainfall in a catchment area, for example 20 percent, may halve the annual discharge from a river. This is why when conditions are only marginally drier than normal a drought situation can readily develop (Gray, 2008).

In addition to their hydrological functions of moving and storing water, they perform many functions from wildlife habitat, flood water attenuation (holding flood water), drinking water resources, to recreation (Pennington & Cech, 2010).

Water resources can also become scarce or reduced due to a lack of precipitation and soil moisture, which will lead to the term called “drought” and its management.

## 2.4 Drought and Drought Management

Drought may be defined as an extended period of rainfall deficit within an otherwise higher rainfall regime. However this definition is subjective for the length of period without rain varies between locations depending on major climatic regimes. Periods of rainfall deficit deemed to be a drought are also, in many cases, based upon rainfall patterns observed over relatively short historical records. In a country with modern records extending back only one to two centuries, a period of five years with a rainfall deficit may be termed a drought despite the fact that such events may have extended naturally to 50 years or more prior to the start of the modern record (Nott, 2006).

Archer and Rahmstorf, (2010), put it simply: a drought occurs when the flow of water is less than normal. This is distinct from seasonal or short-term fluctuation which is repetitive. Drought is the most damaging of all natural disasters (Mays, 2007).

Weather Services defined drought as a period of unusually persistent dry weather that continues long enough to cause serious problems such as crop damage and/or water supply shortages (Pennington & Cech, 2010).

According to Mays (2007) drought can be classified into different types, depending on the viewer:

- A meteorological drought occurs when precipitation is less than normal, generally assessed over the rain season.
- A hydrological drought is when river flow is less than normal. This may not occur simultaneously with meteorological drought, since soil moisture conditions and upstream abstractions affect river flow.
- A groundwater drought may occur due to overuse of the aquifer and could be unrelated to recharge as the time scale is so big.
- An agricultural drought is said to exist if plants reach wilting point.
- An economic drought occurs if there is insufficient water to maintain production.

The hydrological drought contributed to the research being explored. This type of drought invaded the river flow and precipitation in the George municipal area.

Drought is one of four classes of water scarcity (Nott, 2006). These are:

- Aridity, a permanent shortage of water caused by a dry climate;
- Drought, an irregular phenomenon occurring in exceptionally dry years;
- Desiccation, a drying of the landscape, particularly the soil, resulting from activities such as deforestation and over-grazing; and
- Water stress, due to increasing number of people relying on fixed levels of run-offs.

Drought may be seen to be a temporary form of water scarcity, aridity a permanent form and desertification a human- induced form (that may be either temporary or permanent).

The severity of a drought, therefore, is largely determined by its impact on humans rather than arbitrary measure such as the Richter scale for earthquakes. Drought affects both agricultural and urban communities, but the former often feel the effects earlier and more severely than the latter (Nott, 2006).

There are several actions that society may take to prepare against the worst consequences of a drought (Shaw, 2005). Society, represented by government agencies, might

- Provide reliable storage/emergency supplies (build new reservoirs, drill new groundwater wells);
- Dredge rivers;
- Build facilities that allow access to low level waters;
- Provide subsidies to power producers to allow peak power production for air conditioning;
- Increase emergency medical response;
- Provide drought assistants to farmers; and
- Create a government-sponsored water bank.

It is important to highlight the drought types and management actions which play a role in water consumption in South Africa, depending on whether people view water as a valuable commodity or as a scarce resource.

## 2.5 Access to Water in South Africa

Section 27 (b) of the *Constitution of the Republic of South Africa, Act No.108 of 1996* (South Africa, 1996) states that water is a basic need that must be provided to all citizens, and that this is the obligation of government. According to the Constitution, water must be free from contamination and pollution, and people must have access to clean and good quality water.

According to Human (2013b), the *National Water Act No. 36 of 1998* (South Africa, 1998) directly regulates the use of water in South Africa. The overarching objective of the Act is to ensure the beneficial use of water in the public interest. The fundamental principles of the Act centre on the need for sustainability and equity in the protection, use, development, conservation, management and control of water resources.

Human (2013b) then lists the primary and secondary legislation affecting water in South Africa as follows:

- The Constitution of the Republic of South Africa Act, 108 of 1996;
- The Water Service Act, 108 of 1997;

- The Local Government: Municipal Structures Act, 117 of 1998;
- The Local Government: Municipal Systems Act, 32 of 2000; and
- The Local Government: Municipal Finance Management Act, 56 of 2003.

In addition to the key pieces of local government legislation, the following legislation also impacts on the role of water in South Africa:

- The National Water Act, 36 of 1998
- The Division of Revenue Act (DORA) (published annually)
- The National Health Act, 61 of 2003
- The Disaster Management Act, 57 of 2002

At the end of the apartheid era, South Africa ambitiously decided to reform its water laws as a response to both perceived injustice in access and allocation and to growing water scarcity in what is essentially a semi-arid country (43 per cent of the rainfalls on just 13 per cent of the land). When apartheid crumbled in 1994, many South Africans lacked access to a formal water supply, and about half of the country still has no formal water supply, according to the Department of Water Affairs and Forestry (Charter & Varma, 2011).

Water management in South Africa must also address the legacy of the apartheid period, which resulted in unequal development of and access to water resources. In the past, water management authorities approached water scarcity almost exclusively as a supply problem to be solved by achievements of engineering. Very little attention was paid to the economic aspects of water use and to managing the demand for water through economic incentives for water conservation. South Africa has revised its water acts and places a new emphasis on economic aspects of water management in supply, allocation and pricing policies. South Africa has a Department of Water Department Affairs (DWA), but responsibility for management is partly dispersed among other agencies as well (Lange & Hassan, 2006).

In South Africa, water services have been extended to over 18 million people since the first democratic election in 1994 (Eales, 2009). However, the new climate of delivery is occurring within the context of cost recovery and, as such, a vast proportion of households have been disconnected from access to water during the first decade of democracy (McDonald & Pape, 2002).

There is no central institution responsible for water supply, rather, a number of different institutions provide water in the country. Some of these rely on relatively large-scale, technologically-sophisticated infrastructure for collection and long-distance water distribution networks, while others rely mostly on local, small-scale infrastructure such as local boreholes and small dams. Despite these challenges, South Africa has achieved high rates of access to safe drinking water and sanitation. Nearly 100 per cent of the urban population has access to safe drinking water and at least 75 per cent of the rural population for example in the Western Cape Province. Access to sanitation is much lower but has been improving, although slowly (Lange & Hasson, 2006).

Municipalities in South Africa have developed water demand management (WDM) approaches that vary to a great degree depending on whether they view water as a valued commodity or as a scarce resource. Water demand management has been one of the tools used by cities to balance these trade-offs. As South Africa is the world's thirtieth driest nation due to low annual rainfall; the country can hardly afford to waste its water. The country has experimented with various water demand management approaches to encourage (if voluntary) or coerce (if mandatory) households to use water wisely There are clear trade-offs in choosing economic over environmental objectives or both environmental and economic objectives, such as ensuring basic access to poor residents. Cities that prioritise economic objectives by selling water without demand management risk depleting the long-term supply that feeds their urban populations (McDonald & Pape, 2002).

In South Africa all local governments are constitutionally bound to ensure equity to access of water and as such must find a way to balance carefully competing objectives (Yako, 2008). Minimising water wastage in domestic consumption is therefore a key priority for local government.

### 2.5.1 Water availability in South Africa

South Africa is the world's 30th driest country (McDonald & Pape, 2002). South Africa is a large country with a varied climate, with an average annual rainfall of only 500 mm. It is projected to achieve the status of critical water stress in the near future, a situation where annual renewable water resources fall below 1000 cubic metres (Water Research Institute, 1996, cited in Lange & Hassan, 2006).

If the current rate of water usage continues, demand is likely to exceed supply at some point in the not too distant future. As a water-scarce country (when compared against a global rainfall average of 870 mm per year, South Africa only receives approximately 450mm annually) the improvement of water conservation, water quality and water-use efficiency is a key national priority.

Some projections estimate that South Africa already exploits about 98% of its available water supply resources. Water availability will most likely be further restricted in future as a result of climatic conditions and increased demand for water resources through population growth, urbanisation and economic growth (Institute of Directors Southern Africa, 2012).

## 2.6 Climate Change

A climate is the average weather condition of a location and can generally be predicted for centuries into the future (Meyer, 2007).

Globally, insured losses from natural hazards have increased substantially over past years. Increasing population and community vulnerability account for most if not all of this trend; and many suggest that global climate change may be at least playing a role in increasing actual hazard events. Predictions from global climate models suggest that the magnitude and, in some instances, the frequency of atmospherically-generated hazard events will increase (Nott, 2006).

Chartres and Varma (2011) argue that the 15 years of bickering over whether or not climate change is caused by humankind has meant much time and effort that could have been devoted to mitigation and adaption has been lost in debate; the cause is relatively unimportant compared to deciding how to deal with the impact.

Further they maintain that of all the factors affecting future water supplies and agriculture and food production, climate change is the one that we understand least in terms of the likely magnitude, severity of impact, and geographic expression and variation. This is not surprising because much of the science of climate change is new, and only recently the army

of climate change sceptics have begun to accept what was originally a hypothesis is now a reality (Chartres & Varma, 2011). However, the impact of climate change on water resources will be different from place to place (Nott, 2006).

According to Meyer (2007) climate change and global warming and their effects on sub-Saharan Africa are a predictable disaster. The expectations are that climate change and global warming together will change (and are already changing) rainfall and temperature patterns. Some countries will get more precipitation and others less. Generally it is going to become hotter, causing more evaporation and less moisture in the soil.

In water scarce countries a rising fear regarding the security of fresh water supplies is giving rise to efforts to impound greater quantities of fresh water behind massive dams. The goal is to avert shortages and propel industrial development through cheap hydropower. There is growing consensus among scientists that climate change poses an unprecedented threat to the availability and quality of fresh water. Simply stated, areas already experiencing periodic drought or floods are likely to see worse drought in the future, while uneven patterns of precipitation are likely to become even more extreme (Feldman, 2012).

Climate change is expected to alter the present hydrological resources in Southern Africa and add pressure on the adaptability of future water resources (Schulze & Perks, 2000).

## 2.7 Climate of the Western Cape Province

There are five District Municipalities in the Western Cape Province: West Coast, Eden, Central Karoo, Cape Winelands and Overberg, and the City of Cape Town Metropolitan Municipality. In total, there are 30 municipalities across the Province. Water resources are managed on a catchment scale, i.e. per water management area; whereas actual water use is aligned according to municipal boundaries (South Africa. Western Cape Department of Environmental Affairs and Development Planning, 2011).

The Mediterranean climate of the Western Cape differentiates it from the rest of South Africa in that it receives winter rainfall and experiences drier summers whereas the opposite is true for the rest of the country. This is due to its latitudinal position in relation to the band of

westerly waves of air circulation and the associated low pressure systems. These westerly waves contribute to the climate of the Western Cape, bringing rain in the form of cold fronts (Midgely, Chapman, Hewitson, Johnston et al., 2005).

Scientists predict that the Western Cape Province will become dryer in the western regions, and that more rainfall will occur in the eastern regions. George Municipality lies in between, making it difficult to predict what is going to happen in this region. Experience over the past few years indicates that longer dry spells will be experienced, and that more floods or short heavy spells of rain can be expected (George Municipality, 2010).

Severe droughts are quite rare in the Eden district although the drought in the George Municipality over 2009-2011 was similar in severity to celebrated droughts of 132 years ago (Bamford, 2009).

## 2.8 Evidence of Water Shortage in the Eden District

The municipalities located in the Eden district experienced a natural hydrological drought from 2009–2011. The water shortage conditions resulted in almost immediate water restrictions effects on the urban areas. Also, condensed rainfall resulted in numerous penalties to ground and surface water resources that translated into critically low urban water supplies in the George. Over this period the water shortages conditions necessitated significant emergency responses in George (Basson & Mooiman, 2010).

The Department of Water Affairs prioritized support for parts of the country affected by the prevailing drought conditions during 2009. According to statistics gathered by the Department, George experienced the lowest 12 consecutive months of rainfall since 1921 and was considered severely dry. The drought conditions started around March 2008 (Water Rhapsody, 2010).

George Municipality faced the prospect of taps running dry. It became known as the “green drought” because while the area still looked lush and fertile; dam levels were plummeting and rivers were slowing. The long-term prediction for the municipal area was awful, with minimum rain excepted in mid-summer during the peak holiday season and the influx of visitors

meaning some areas would double in population. There was a perception that there was sufficient water because the area was still so green, but there was barely water in the dams. The GRD was depleting and dropping about 1 per cent per week (Bamford, 2009).

Water Rhapsody (2010) reported that at its lowest the GRD storage was 30 per cent (7 per cent below the median storage) and. the Wolwedans Dam storage was 37.1 per cent (60 per cent below the median storage) and gradually declining.

Having received an annual rainfall of 477mm in 2009, only 63 percent of the area's mean annual precipitation (the average amount of rainfall received annually), urgent measures had to be put in place to deal with the water shortages, including the introduction of severe water restrictions, re-directing sewage water to the purification plants and desalinating sea water to augment supply.

The water shortages started in January 2009 as a result of low rainfall. After a dry and hot summer in January 2009 peak holiday season, and no rain relief, the GRD had dropped to a level of 60 per cent. In April 2009 George Municipality introduced water restrictions (Basson & Mooiman, 2010).


**Figure 2.1 George Municipality**

(Source: http://www.westerncape.gov.za/your_gov/18 )

Water restrictions included limiting or prohibiting outdoor water use. The George municipal area's vehicle registration, CAW, was traditionally known as "cold and wet", but that no longer applied (Bamford, 2009).

A full-scale public awareness campaign was launched to urge residents and business to cut consumption by at least 30 per cent. If the dams dropped to 25 per cent punitive charges would kick in and residents would have to pay double for extra water used (Bamford, 2009).

The MEC for Local Government in the Western Cape instructed George Municipality to set measures in place to ease the water shortage. Initially, the water restrictions had little impact on water consumption and were intensified in June 2009 when the GRD dropped to a level of 45 per cent. Rainfall was minimal, and the raw water source was under increasing stress while consumption remained high (Basson & Mooiman, 2010).

### 2.8.1 Water supply

Water is the sustaining source of life and hence access to safe and potable water is a priority in service delivery and is also guaranteed in the Bill of Rights entrenched in the Constitution. George Municipality provides water to all households and adheres to the minimum service level requirements for the provision of clean drinkable water (George Municipality, 2013). Table 2.1 indicates the various types of water sources available to households in 2011.

| Source of Water | Nr of HH | % of HH |
|---|---|---|
| Regional/local water scheme (operated by municipality or other water services provider) | 4 7595 | 89 |
| Borehole | 1064 | 2 |
| Spring | 408 | 1 |
| Rain water tank | 1 513 | 3 |
| Dam/pool/stagnant water | 1 268 | 2 |
| River/stream | 401 | 1 |
| Water vendor | 90 | 0 |
| Water tanker | 546 | 1 |
| Other | 667 | 1 |
| Not applicable | - | - |
| **Total** | **53 551** | **100** |

**Figure 2.2: Main source of water used by households, 2011**

(Source: George Municipality IDP 2013/14.)

### 2.8.2 Population size and growth

Demographic information provides relevant statistical information to government and policy decision-makers. It is also an important guide for informing service needs (social and economic); policy development and intervention; identifying targeted intervention programmes, their implementation and evaluation (George Municipality, 2013).

Eden district's total population is 574 265, representing 9.8 per cent of the Western Cape Province total population of 5 822 734 million. George Municipality has the largest population in the Eden District: the population was estimated at 193 672 in the 2011 census, which represents a growth of 29.1 per cent from 2001-2011(George Municipality, 2013).

Figure 2.3 gives the distribution of the Eden district population.

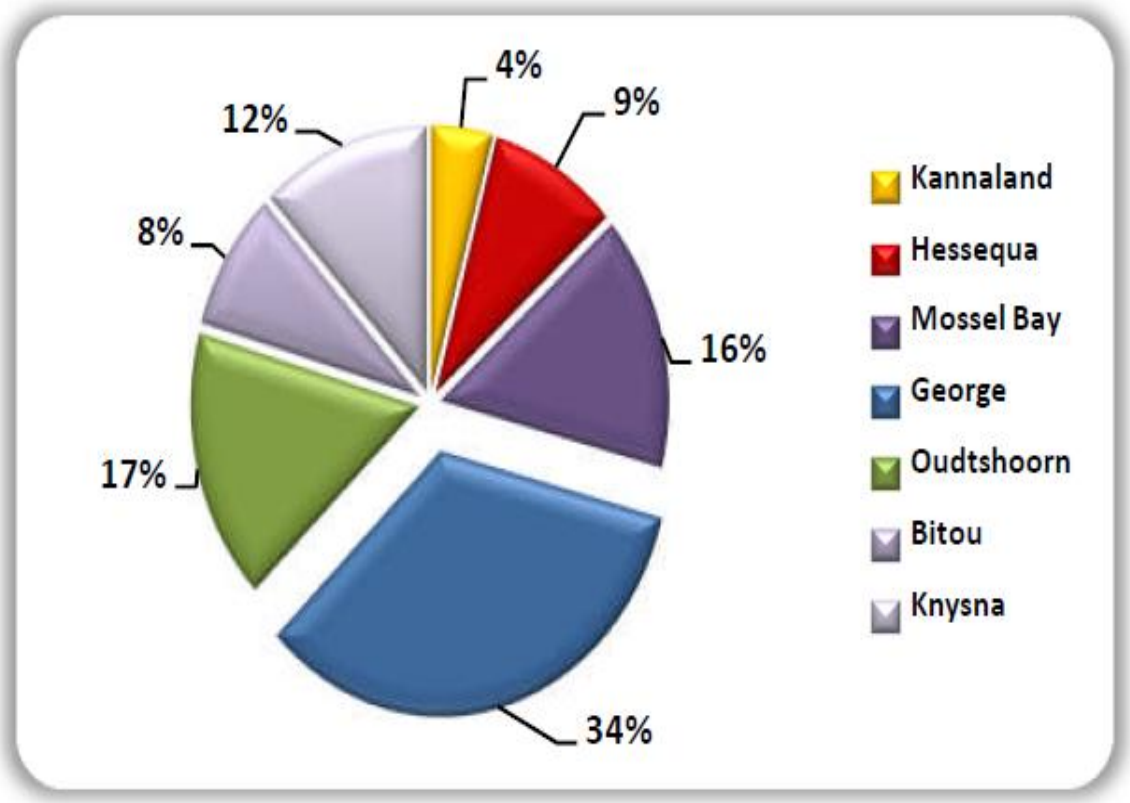



**Figure 2.3 Population per municipality in Eden District**
(Source: George Municipality IDP 2013/14)

Population size and growth exerts particular pressure on water supplies. The growth in the George population should be seen against the global trends.

Global population is expected to climb from approximately 6.7 billion in 2009 to 9 billion in 2025. Given that fresh water supplies are finite, this means smaller shares for all and more widespread physical water scarcity and water stress. These stresses have symptomatic expression of scarcity, leading to potential conflict (usually political rather than physical) at a

trans-boundary level and competition between water users. In extreme case physical scarcity coupled with drought leads to regional famine (Chartres & Varma, 2011).

According to Van Rooijen, Evans, Venor, & Drechsel (2011) rapid urban development and industrial growth put direct and indirect pressure on fresh water resources in many water-scarce basins. Direct pressures derive from domestic and industrial demand, while indirect pressure relates to an increasing urban food demand.

Population density affects water stress since a high concentration of users in a given area means that the local precipitation (or, more frequently, the local precipitation plus water imported from elsewhere), must be sufficient to meet local needs. The trend towards urbanisation is focusing on the growth of water demand in the domestic sector on urban water users and their needs for expanded access to special supply and treatment capabilities (Lawford, 2011).

Urbanisation also leads to increased infrastructure costs, including cost of water delivery systems, sewage and storm sewage systems and water treatment. As the demand for water increases in a future warmer climate it will lead to increased water stress, especially in areas where temperatures increases and precipitation decreases. Warmer temperatures will lead to other management issues because they are also likely to lead to increased evaporation losses from surface water storage ponds and less efficient irrigation (Lawford, 2011).

### 2.8.3 Climate change in the George municipal area

Water demand will be affected by climate change and climate change is likely to be accompanied by increases in the frequency of extreme events (primarily floods and droughts). Given the growing recognition of the need for climate change adaptation, water managers are increasingly expected to be experts on adapting to climate change. As a result, many water resource managers want to know how climate could affect their watershed areas over foreseeable horizons. Some managers are beginning to incorporate larger margins of error in their design and operations to accommodate potential uncertainties associated with climate change (Lawford, 2011).

During the George drought climate change was being blamed for the drought and residents feared that the lack of rain might be the start of a cycle of dry seasons, threatening the region's long-term water supply. Scientists predicted that without good rains the George municipal area would have enough potable water to last only until February 2010. Water restrictions were tight and water police were been deployed across the Eden district to ensure that users complied with restrictions Despite the water crisis, local residents welcomed visitors to the George municipal area as long as they kept their water usage under control (*Mail & Guardian*, 2009).

This request was needed to support the water crisis as indicated in the trend line of the dam level of the GRD.

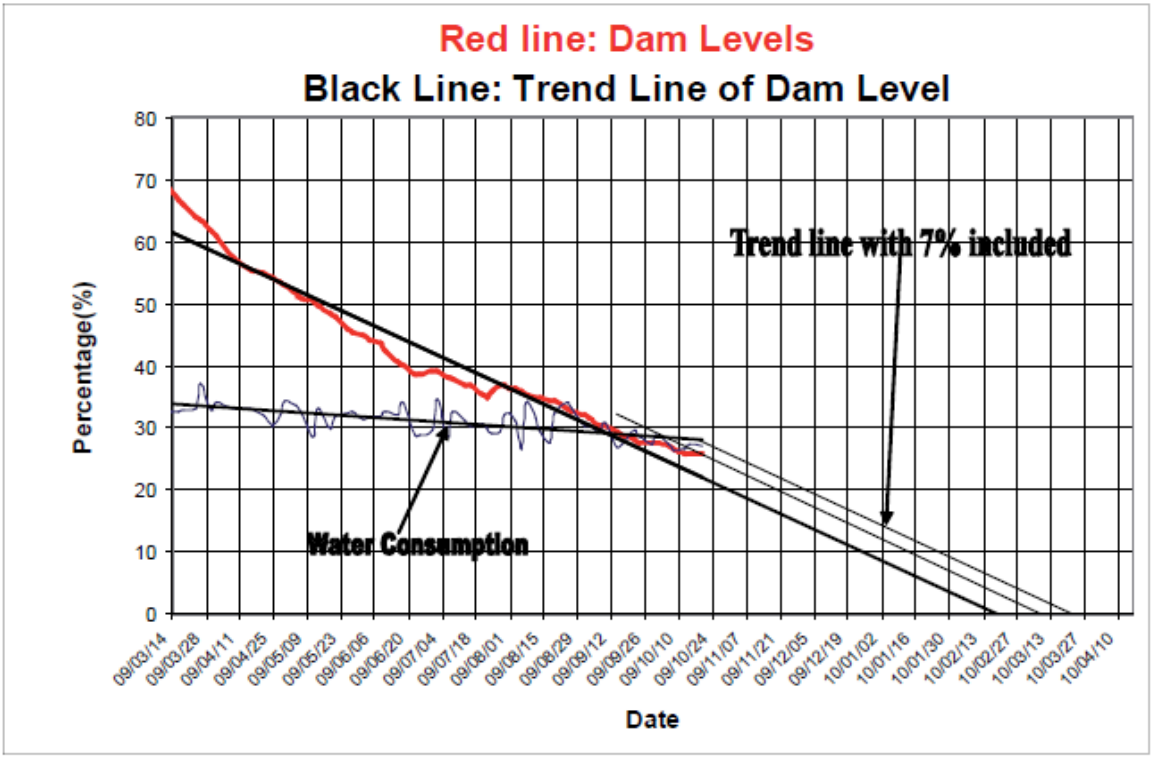



**Figure 2.4: GRD Trend Line of Dam Level 2009-2010**

(Source: Basson & Mooiman, 2010)

Figure 2.4 indicates the trend line of the dam level. After a close assessment of local conditions, it was determined that without intervention, and if unfavourable rainfall predications were realised, George's raw water supply would be depleted by February 2010.

The following photographs compare water levels in the GRD:

**Figure 2.5: GRD – Full**

(Source: Basson & Mooiman, 2010)

**Figure 2.6: GRD - Low (26 per cent full)**

(Source: Basson & Mooiman, 2010)

In terms of adapting to climate change, water systems will need to be more robust. New or alternative sources of water supply may need to be found for future projections. This will entail increased skills from water managers and long-term water projections.

An overall decrease in rainfall is generally not forecasted in 2013/14, but increased variability in the climate and frequency of extreme events, as well as increased temperature and wind could have an impact on water sources, particularly surface waters (Human, 2013b).

### 2.8.4 Water levels

The rainfall statistics are based on official data obtained from the Weather Service Office in George Airport. Rainfall is also measured at other stations in George. The most applicable rainfall data with regard to the catchment area is measured at the station at the water treatment plant. For drought comparison purposes, the Weather Service data were used (George Municipality, 2010).

The GRD constitutes the primary water supply for the George Municipality. The sustainability of the George municipal area water supply depends on seasonal rainfall to fill the dam, with full storage in the winter months to provide for water demand in the municipal area. The tight relationship between rainfall, dam levels and water consumption shows the close connotation between rainfall, water consumption and the increase or decrease in the GRD level (Human, 2013a).

The George municipal area experienced well below average rainfall in 2008 and also consistently below average rainfall throughout 2009 (Basson & Mooiman, 2010). The rainfall recorded at the Airport up to the end of November, 2009 336, 9 mm; the average for the 132 years for the same period was 796.53 mm. The rainfall for 2009 was therefore 42 per cent of the average. It was also nearly 100 mm less than the lowest recorded rainfall, in 1946, the previously lowest recorded annual rainfall. If the 12 month period from December 2008 was analysed, the figures become even worse (Bamford, 2009).

Overall the annual average for 2009 varied between 42 per cent and 56 per cent as measured at various rain metering stations.

The drought was, by a large margin, the most severe in recorded history. The situation was therefore extremely serious and could not have been anticipated. It was very difficult to provide for a drought of the nature being experienced. The prevention of an emergency situation such as the one that was being experienced would be extremely challenging, given the financial affordability problems associated with it, and the financial impact on the residents (George Municipality, 2010).

The dam level remained almost static in 2009. This can be attributed to the early December 2009 rainfall and reduced consumption. The severe water restrictions resulted in a reduction of 30 per cent in the average daily consumption by December 2009. The Municipality aimed to reduce consumption even further for the period under review (EDM, 2010).

For this study a number of weather stations were selected to provide a regional overview of the monthly rainfall received during 2009.

George rainfall data: Total annual rainfall for George amounted to 52 per cent of the long-term mean. This weather station is not located in the GRD catchment area.

Figure 2.7 below indicates the cumulative rainfall in 2009. Until the disaster management meeting, in August 2009, George Municipality had focussed on measures traditionally used to manage and reduce consumption in times of water stress i.e. water restrictions.

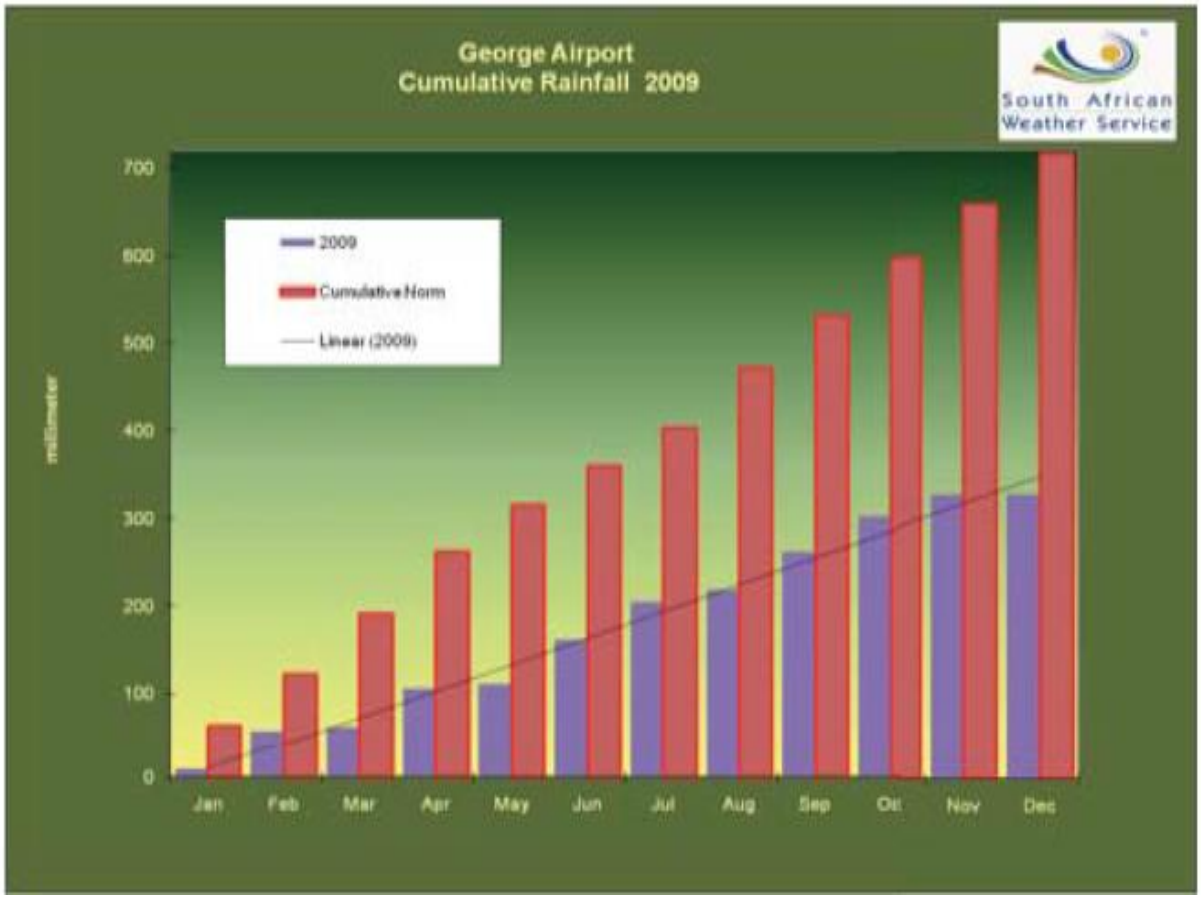
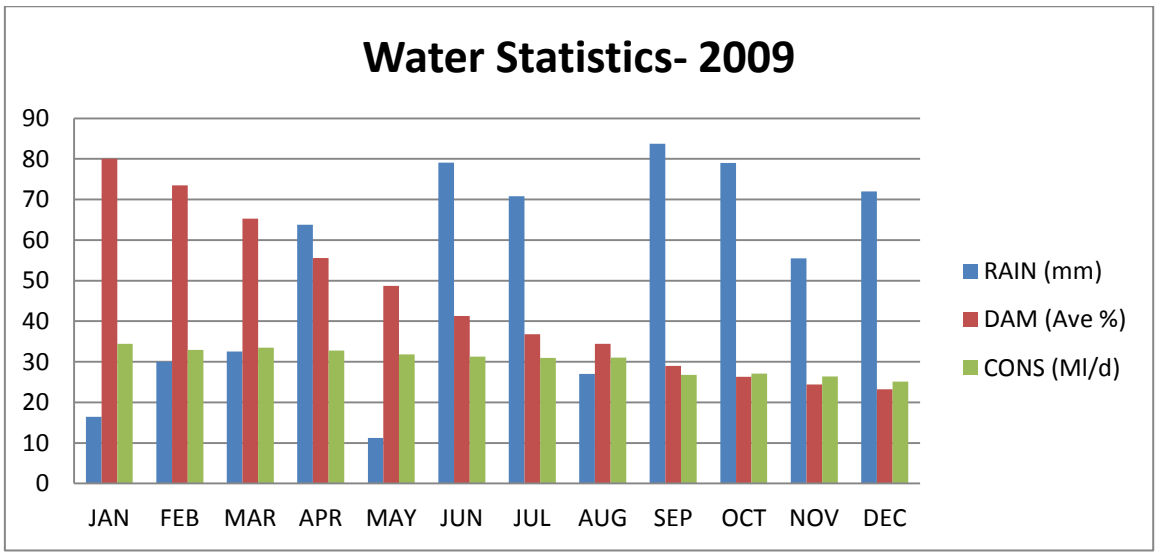



**Figure: 2.7: Cumulative rainfall on 2009**

(Source: South African Weather Services (SAWS), George weather office, as quoted in George Municipality, 2010)

The dam levels, shown in Figures 2.8 – 2.10 below also reflect the severity of the crisis.

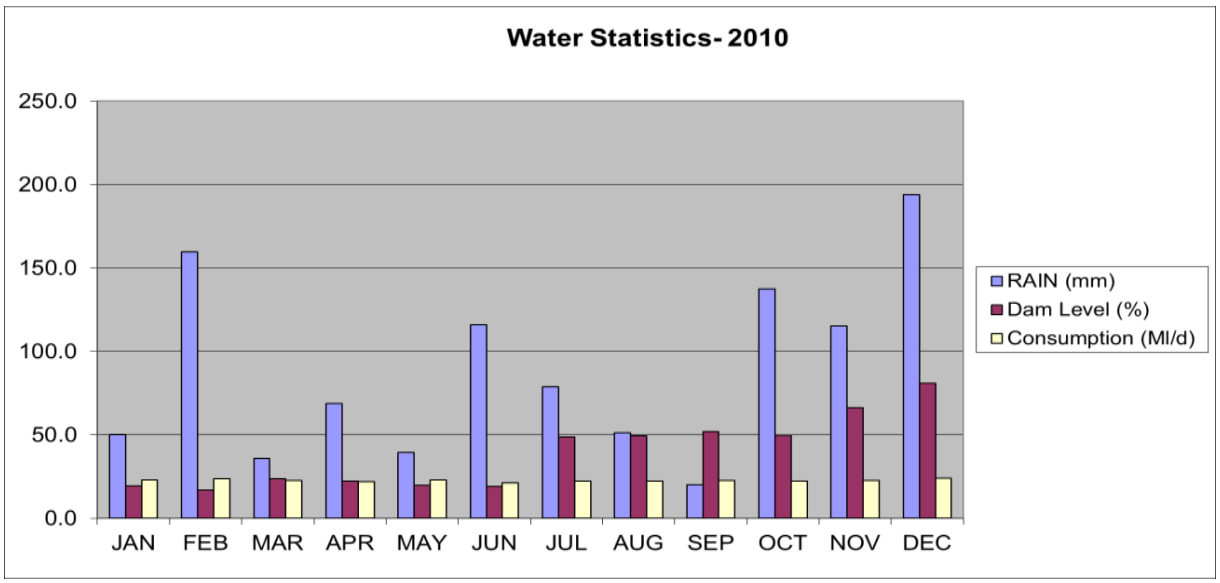



| 2009 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAIN (mm) | 16.45 | 30.0 | 32.5 | 63.8 | 11.2 | 79.1 | 70.8 | 27.0 | 83.7 | 79.0 | 55.5 | 72.0 | 51.75417 |
| DAM (Ave %) | 80 | 73.5 | 65.3 | 55.6 | 48.7 | 41.3 | 36.8 | 34.4 | 29.0 | 26.3 | 24.4 | 23.2 | 44.875 |
| CONS (Ml/d) | 34.43 | 32.92 | 33.46 | 32.76 | 31.81 | 31.25 | 30.92 | 31.01 | 26.78 | 27.10 | 26.35 | 25.08 | 30.3225 |

**Figure 2.8: Water statistics, 2009**

(Source: South African Weather Services (SAWS), George weather office, as quoted in George Municipality, 2010)

Figure 2.8 indicates that the George municipal area experienced well below average dam levels in 2009. The annual average rainfall for 2009 indicates 51.75 mm as measured at various rain metering stations. Dam levels indicated an average of 44.87 per cent and consumption at 30.32 per cent. In other words, comparing the dam level and consumption level indicates that water consumers were almost consuming the same as the dam level.

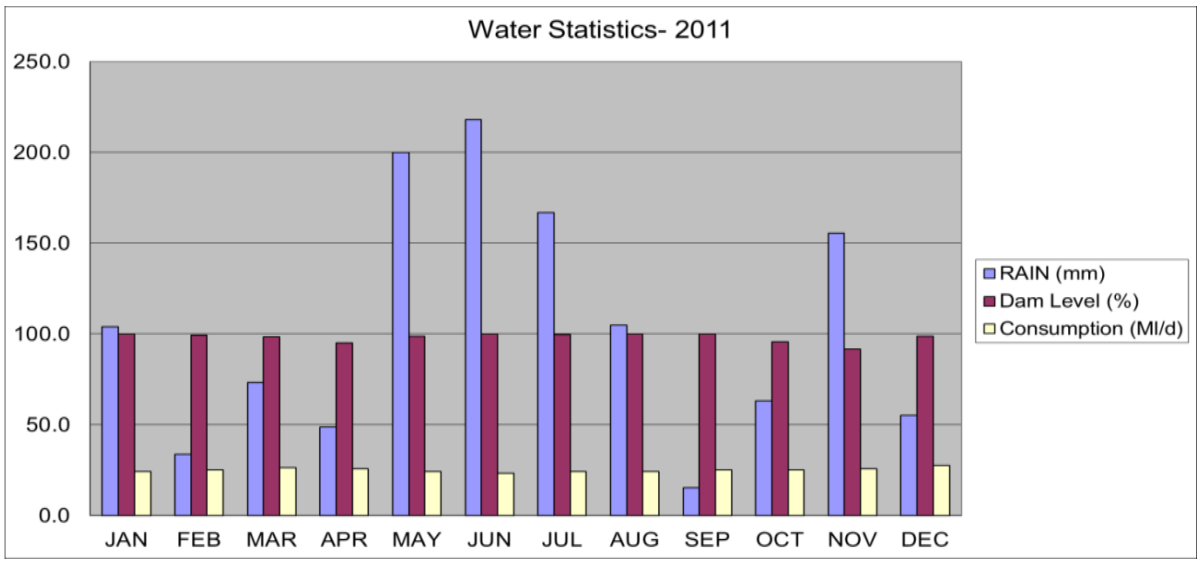



| 2010 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAIN (mm) | 50.0 | 159.5 | 36.0 | 68.7 | 39.6 | 116.0 | 78.9 | 51.2 | 20.1 | 137.5 | 115.3 | 194.0 | 88.9 |
| DAM (Ave %) | 19.5 | 17 | 24 | 22 | 20 | 19 | 49 | 50 | 51.82 | 50 | 66 | 81 | 39.0 |
| CONS (Ml/d) | 22.92 | 23.87 | 22.59 | 22.03 | 23.04 | 21.34 | 22.42 | 22.36 | 22.53 | 22.08 | 22.55 | 24.18 | 22.7 |

**Figure 2.9: Water statistics, 2010**

(Source: South African Weather Services (SAWS), George weather office, as quoted in George Municipality, 2010)

Figure 2.9 indicates that the George municipal area experienced the worst average dam level in 2010. The annual average rainfall for 2010 indicates 88.9 mm as measured at various rain metering stations. Average dam levels indicated an average of 39 per cent and consumption at 22.7 per cent. These were the worst levels in the water shortage period.




| 2011 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAIN (mm) | 103.8 | 33.7 | 73.3 | 48.7 | 199.8 | 218.2 | 166.7 | 105.0 | 15.3 | 63.0 | 155.5 | 55.2 | 103 |
| DAM (Ave %) | 100 | 99 | 98 | 95 | 99 | 100 | 100 | 100 | 100 | 96 | 92 | 99 | 98 |
| CONS (Ml/d) | 24.21 | 25.08 | 26.19 | 25.82 | 24.04 | 23.20 | 24.10 | 24.29 | 25.16 | 25.17 | 25.71 | 27.61 | 25 |

**Figure 2.10: Water statistics, 2011**

(Source: South African Weather Services (SAWS), George weather office, as quoted in George Municipality, 2010)

Figure 2.10 indicates that by 2011 the George municipal area had improved in all three categories. Average dam levels were satisfactory and also consistently well above the average rainfall throughout 2011. The annual average rainfall for 2011 indicated 103 mm as measured at various rains metering stations.

### 2.8.5 Weather forecast

The following weather forecast conditions indicated the short- and long-term predications in 2009-2011.

#### *2.8.5.1 Short-term weather forecast*

In December 2009 George Municipality compared the February 2010 and November 2009 forecasts, as per Fig. 2.11 below.

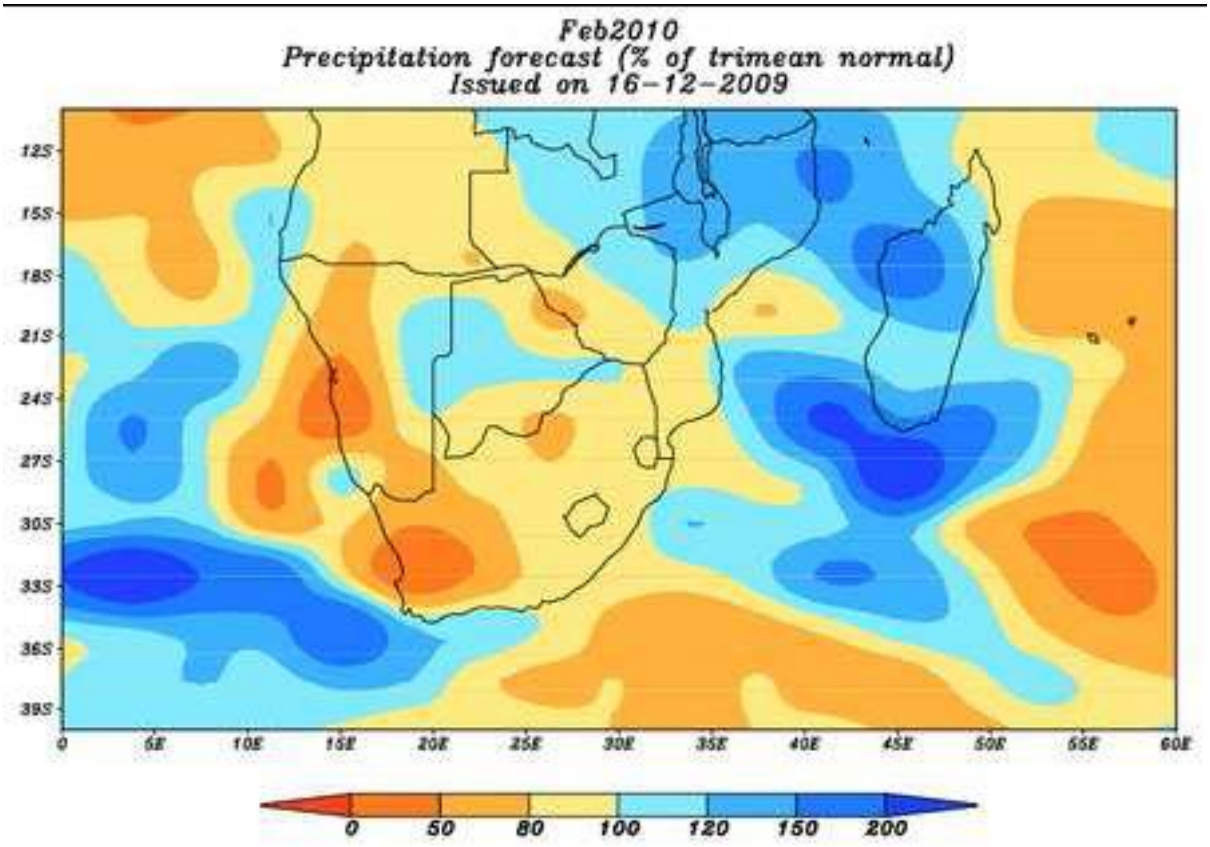



**Figure 2.11: Short-term weather forecast**

(Source: George Weather Office, quoted in George Municipality, 2010)

The figure indicates an improved expectation for rainfall. According to this forecast the rainfall expected for February 2010 would probably be average and amount to between 80 and 120 per cent of long-term weather forecast. This meant that restrictions on water could be alleviated (George Municipality, 2010).

### *2.8.5.2 Long-term weather forecast*

The forecast for March 2010 remained below average whereas conditions for rain started to improve in April 2010 and especially June 2010 (Figure. 2.12) indicating that up to 150 per cent of the mean rainfall was expected.

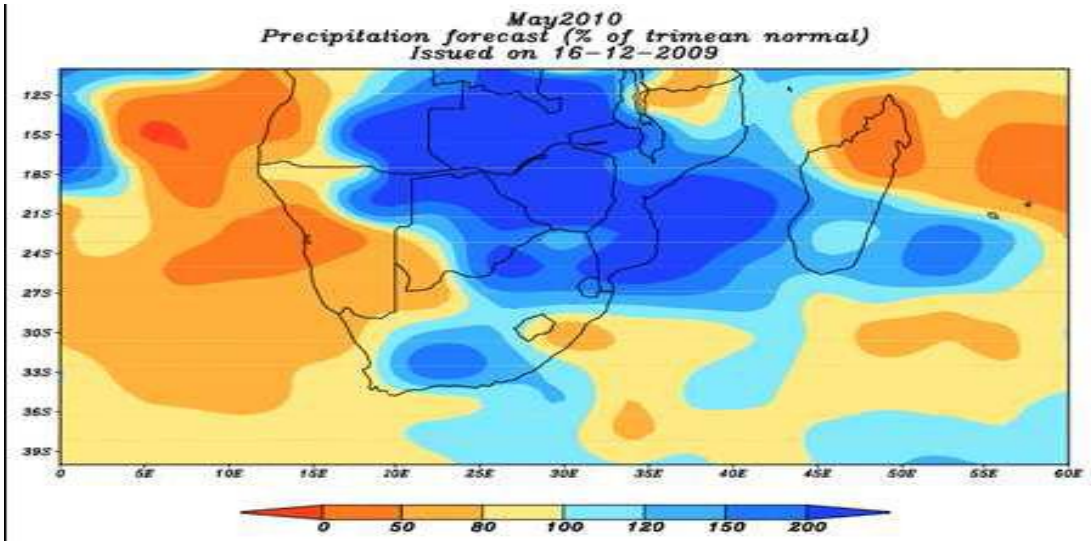



**Figure 2.12: Long-term weather forecast**

(Source: George Weather Office, quoted in George Municipality, 2010)

The quarterly outlook for 2011 rain improved in line with the monthly forecast.

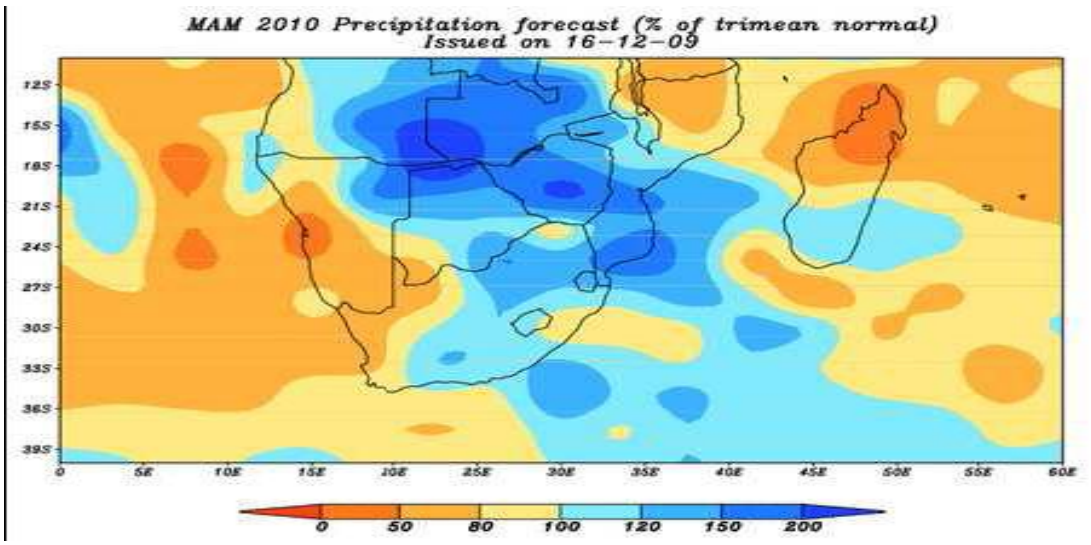



**Figure 2.13: Monthly weather forecast**

(Source: George Weather Office, quoted in George Municipality, 2010)

## 2.9 Bulk Water Resource Planning

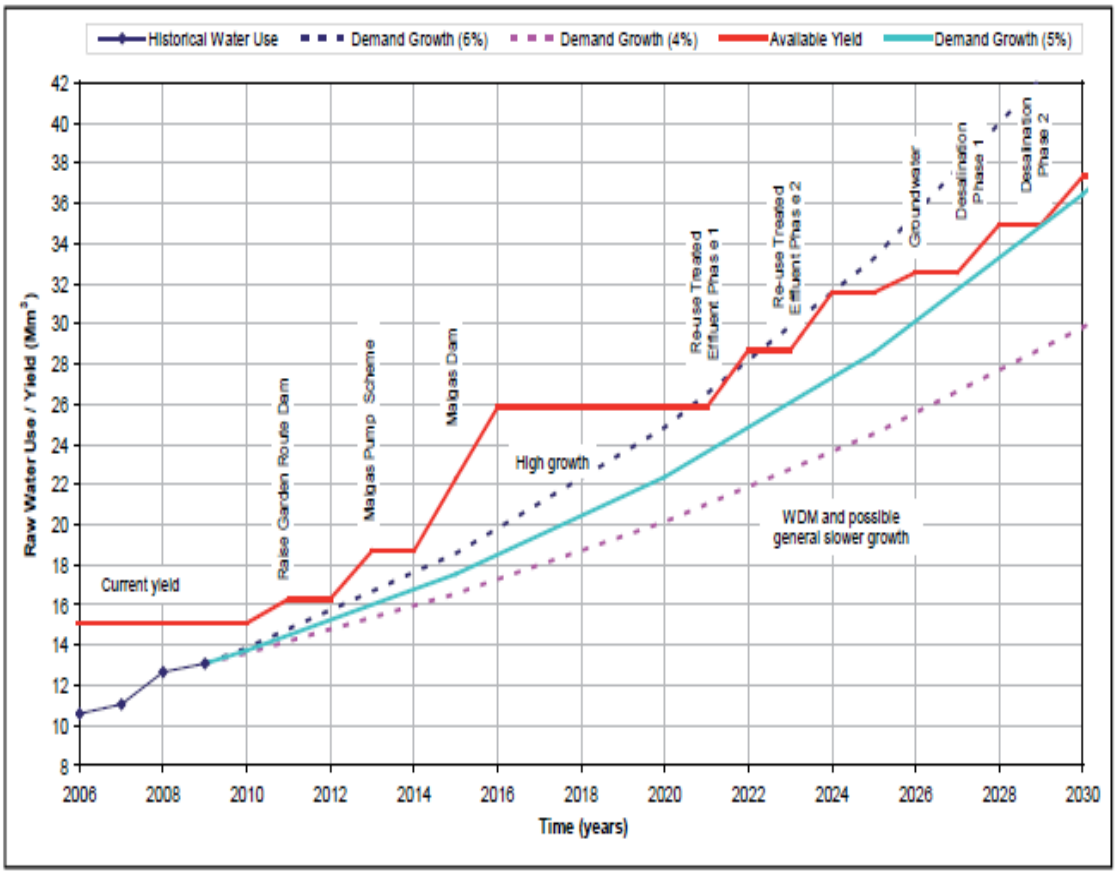



**Figure 2.14: Bulk water resource planning**

(Source: Basson & Mooiman, 2010)

Figure 2.14 indicates the options identified, in a workshop to determine implementation order and priorities. The GRD and the Swart River Dam, provide an assured yield per annum. The Kaaimans River Weir and Pump Station Scheme that discharge directly into the GRD were rehabilitated and reinstated in 2008, increasing the yield per annum (Basson & Mooiman, 2010).

George Municipality had also requested professional tenders for various projects on the 2009/2010 three year capital budget and consultants had been appointed for all the relevant projects. Basically, had George Municipality not had all the necessary plans in place, the outcome of this severe drought would have been an extreme disaster for the George municipal area (George, 2010).

During a 2005 study of bulk raw water resources, a report was compiled that indicated limited ground water resources in the George area. The EDM provided R1.5 million for the drilling of

exploratory boreholes. Twenty boreholes were drilled, varying in depth, generally between 180m and 300m. The quality of the ground water was generally excellent, with high iron and manganese content that could be treated easily (Basson & Mooiman, 2010).

## 2.10 Public Awareness

An overall drought preparedness and management programme must proactively incorporate risk assessment and planning for various sectors and population groups, to reduce the risk of identifying and adopting appropriate mitigation measures (Wilhite, 2000 cited in Low, 2005).

According to Low (2005) monitoring, prediction and early (regular updated) warning are considered to be the foundation for appropriate responses and recovery measures, which require the development of an organisation framework and institutional capacity.

Capacity building needs in Africa for education, training and awareness include the development or the improvement of national programmes for formal or non-formal education, as well as raising awareness on climate issues in academic and research institutions and amount the public at large (Low, 2005).

George Municipality implemented a Public Awareness Campaign in 2009 to 2011, including the following general measures (Basson & Mooiman, 2010):

- Banners on main access roads
- Lamp post posters for certain areas in George
- Billboard signage at main entrances to various areas
- Posters at public places: municipal offices, libraries, clinics, etc.
- Information on digital screen in accounts payment offices and plasma screens in municipal offices and other areas in town
- SMS messages sent to all schools with SMS system
- Presentations for business groups (hoteliers, estate agents, school principals, Chamber of Commerce)
- Presentations done at all schools
- Competition between schools to initiate water conservation
- Brochures on Water Saving for high bulk users, schools, hostels, prisons, hotels

- Information centre during November 2009 at the regional mall, the Garden Route Mall
- Presentations and information for Ward Committees
- Information printed on rates, water and electricity accounts
- Water Saving Tips publicised in prominent places
- Water savings pamphlet distributed with municipal accounts
- Press releases to George Herald, Die Burger, EP Herald and Cape Argus
- 'CAUGHT WASTING WATER' campaign and press releases in newspapers
- Presentations to all municipal employees
- High water users identified and approached individually to cut water use
- Repairs to leaks in indigent areas done free of charge and advertised
- Airlines contacted and requested to make announcements on landing
- Tour companies alerted to drought situation.

Additional Measures

- Public showers and taps at beaches disconnected
- Public taps disconnected on municipal property e.g. at graveyards
- Campaign to ensure each public toilet had a brick/hippo bag, and residents installed flow reducing devices on private showers and taps
- Indigents encouraged to report leaks in their homes; these were repaired at no cost
- A 24-hour crime-line for reporting water abuse
- Additional law enforcement personnel to monitor water abuse and enforce restrictions
- Roving road blocks to hand out pamphlets
- Intense promotion of rain water harvesting
- Internal Drought Management Committee – met 3 times per week (Departments of Civil Engineering Services, Financial Services and Community Safety).

## 2.11 Water Demand Management Strategy

According to the Human (2013a) to meet the challenge of growing demand on raw water resources, and to ensure that growth and development remains sustainable in the George municipal area, the George Municipality committed itself, as far as practically possible, to uphold and continually impose the water demand management (WDM) measures currently in

place, and to impose new measures where water demand management could be further improved.

The water demand management measures by the George Municipality include:

- Water Master Plan – updated quarterly
- Block Tariffs
- Pipe replacement and maintenance program
- Complaints system
- Standby teams for immediate repair of burst pipes
- Pressure management
- Working for Water
- Promoting use of water efficient fittings
- Public Awareness
- Zone metering
- Telemetry system
- Installation of bulk meters in existing areas for monitoring
- Accurate records of water use and losses
- Promote rain water harvesting
- Promote indigenous gardens
- Water restrictions
- Strict municipal services standards for installing new water reticulation for own and private developments.
- Reticulation material and quality standards – facilitates maintenance
- Up to date Water Service Development Plan
- All large development applications need to be supported with evidence of WDM interventions
- All new medium and large developments to have detailed WDM plan
- Improvement of water treatment process has resulted in less flushing of pipeline and the resultant water savings.

Grey water comprises all household wastewater - except that from the toilet (black water) - and originates from the bath, shower, hand basin and from laundry. Waste water from the kitchen sink is included in the definition of grey water by some authors, but is excluded by others because it carries higher pollutant loads in terms of particulate matters; oils, fat, and

grease and bacteria. In urban South Africa, almost all grey water is disposed of to the sewer systems (Harding, 2011).

The implementation of a WDM Strategy by George Municipality has been extremely successful and has reduced the town's water losses: from 26.97 per cent for the 2010/2011 financial year to 23.56 per cent for the 2011/2012 financial year (Human, 2013b).

According to (Human, 2013b) the WDM strategy refers to measures that reduce water wastage and inefficient use, and includes measures to effectively manage and sustain efficiency targets. Some of the priority requirements are to install systems that measure and identify certain key parameters, such as minimum night flows, and systems to enable detailed and regular water audits and water balances.

## 2.12 Water Service Authority

Water conversation is designed to stretch the region's supplies, to reduce impacts of ground water pumping, and to demonstrate to state and provincial agencies that a region is using water efficiently. Each water purveyor (source) has a detailed conservation plan tailored to its needs and capabilities (Loux, 2011)

George Municipality is the official water service authority for the entire municipal management area and acts as the water safety plan for the municipal area. It previously approved the Water Service Development Plan in the 2010/2011 financial year updated this for the 2013/2014 financial year (Human, 2013b).

The required policies, for example the drought policy and by-laws for water and sanitation, provision are in place. The water services by-laws cover the provision of services for water supply, sanitation and industrial effluent and are actively implemented by the Municipality. It continues to undertake basic public awareness programmes. According to Human (2013a) George Municipality is currently effectively managing its water and sanitation services.

George Municipality achieved a drastic drop in their total bulk water demand over the period 2009-2011, through the implementation of their WDM strategy. It prevented potential shortfalls in supply through the implementation strategy and the augmentation of their existing sources. Future WDM measures to be implemented by George Municipality include the installation of low-flow shower heads and dual-flush, low-flow toilet cisterns (Human, 2013a).

The Municipality has also investigated various augmentation options over the last few years to meet projected future water demands. The raising of the GRD wall is in planning stage. Investing in infrastructure creates an enabling environment for economic growth and is an important pre-condition for sustainable growth. Although George Municipality has a potential for growth at much higher rates, failure to ensure adequate rehabilitation and maintenance of the existing infrastructure poses a serious threat to the local economy (Human, 2013b).

The deterioration of water and sewer networks and pump stations and rapid development, which is not always matched by growing capital expenditure, can further worsen the situation. George Municipality therefore needs to continue the rehabilitation and maintenance of their existing infrastructure to ensure the medium- to long-term sustainability of the existing infrastructure (Human, 2013b).

The Municipality actively implements their WDM strategy and various WDM activities to reduce their current percentage of non-revenue water as far as possible and keep future water demand as low as possible (Human, 2013b).

## 2.13 Chapter Summary

From the literature it is obvious that various plans were implemented regarding the water shortage in George, the worst hit municipality in the Eden district.

The water shortages were by a large margin the most severe in recorded history. The situation was therefore extremely serious and could not have been anticipated. The Municipality successfully implemented emergency measures and restrictions to alleviate the water shortage.

Municipalities on the Garden Route mostly met a Department of Water Affairs target to cut water abstraction by 40 per cent. George Municipality achieved a 42 per cent saving while most others were around 38 per cent (Oelofse, 2010).

# CHAPTER THREE
# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter outlines the research methodology, that is, the approach used to produce knowledge through the research. The data collection tool is described in detail. The research process is further explained in terms of the identification and administration of the interviews. The researcher then discusses the efforts applied to ensure the reliability of the data, and the themes extracted from the data. Analysis of the data is also provided.

## 3.2 Research Methodology

According to Welman, Kruger and Mitchell (2005:2) research methodology "considers and explains the logic behind research methods and techniques". It refers to the system of collecting data. Research methodology, in other words, details the theoretical and practical steps to be followed in the process of data collection.

There are two approaches to research a problem, namely qualitative research and quantitative research. The researcher adopted a qualitative research approach as it was best suited to explore how water shortages were managed in the study area.

The qualitative research approach is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that makes the world visible. The following practices turn the world into a series of representations: field notes, interviews, conversations, photographs, recordings and memos to self. Qualitative researchers study things in their natural settings, attempting to make sense of or to interpret phenomena in terms of the meanings people bring to them (Ritchie & Lewis, 2003).

Lapan and Quartaroli (2009) contend that to a researcher who collects qualitative data, all words, pictures, and articles are rich sources of information. The analysis of qualitative data involves reducing the many words, images and artefacts that are collected during the research process into a more manageable form to tell a story about the people or groups that are the focus of the research. At this point, the researcher is not done; an interpretation of

the story is needed to make the results meaningful to both the participants in the study and readers of the report.

This differs from the quantitative research approach method that places emphasis on the collection of empirical data, the calculation of exact measurements and the testing of hypotheses. Welman, Kruger and Mitchell (2005: 8-9) characterise qualitative research as:

- It deals with subjective data produced by the minds of the respondent or interviewees (i.e. human beings).
- The result is presented in language (i.e. significant of the respondent) instead of numbers.
- Research is flexible and explorative because it enables the researcher to change the data progressively so that a deeper understanding of what is being investigated can be achieved.
- The researcher investigates constraints on a day-to-day event and bases their results on the daily events and behaviour of people.
- Qualitative researchers try to achieve an insider view by talking to subjects or observing their behaviour in a subjective way.
- The researcher works with the dynamic and changeable nature of reality.
- Qualitative researchers make use of a holistic approach, that is, they collect a wide array of data, for example documentation, records, photos, observations, interviews and case studies.
- Validity is considered as more important because of what the researcher investigating.
- Small samples of people, studies by means of in-depth methods.

The above proved appropriate and relevant to the study.

### 3.2.1 Data collection

Data collection is the gathering of data by different sources of information (Sekaran, 2003). The researcher conducted in-depth interviews, which led to a greater understanding of the measures implemented and to a better analysis of results at a later stage. Six participants were purposely selected to participate in the study as they were the responsible persons

employed at the George Municipality; they could provide first-hand information on the measures implemented to alleviate the problem and on the water shortage status.

**Table 3.1: Study participants: designation and department within George Municipality**

| Designation | Department |
|---|---|
| Director | Civil Engineering Services: Water and Sanitation Services |
| Senior Manager Operations | Civil Engineering Services: Water and Sanitation Services |
| Manager | Civil Engineering Services |
| Manager | Civil Engineering Services: Water and Sanitation Services, |
| Manager | Disaster Management Services |
| Marketing Coordinator | Civil Engineering Services: Water and Sanitation Services |

A key feature of in-depth interviews is the depth of focus on the individual. It provides an opportunity for detailed investigation of each person's personal perspective, for an in-depth understanding of the personal context within the research phenomenon located, and for very detailed subject coverage. Ritchie and Lewis (2003) maintain it is the only way to collect data where it is important to locate the perspective within the context of personal history or experience, and where it is important to relate different issues to individual personal circumstances.

At the same time, the researcher (interviewer) should ask all the questions in the interview that are relevant to the research. Open questions should allow room for the specific, personal views of the interviewees but avoid influencing them. Such interview questions should be combined with more focused questions, which are intended to lead the interviewees beyond general, superficial answers and to introduce issues that the interviewees would not have mentioned spontaneously (Flick, 2011).

### 3.2.2 Ethical considerations

The in-depth, unstructured nature of qualitative research, and the fact that it raises issues that are not always anticipated, means that ethical considerations have a particular resonance in qualitative research studies (Ritchie & Lewis, 2003).

#### *3.2.2.1 Informed consent*

Permission for respondents to participate in the research as 'sample members' should be obtained. This means providing participants with information about the purpose of the study, how the data will be used, and what participation will be required of them. Whether participants will be identified or comments attributed to them in any report should be made clear (Ritchie & Lewis, 2003).

Informed consent should be based on an understanding that participation is voluntary – an issue that may require particular emphasis where research is conducted by people who also have a professional relationship with sample members, which may lead to feelings of obligation or gratitude (Welman, Kruger & Mitchell, 2005).

Permission from the research participants to participate in the research was obtained. The researcher informed participants and respondents that participation was voluntary, that their consent was required, that they could choose to participate or not, and that they also had the right to withdraw from the study at any time without penalty.

#### *3.2.2.2 Protecting participants from harm*

It is important to give consideration to ways in which participation may be harmful to sample members, and to take aversive action. Discomfort and harm can be physical, emotional, economic, social or legal. Respondents or participants may appear comfortable and may disclose information apparently willingly during the interview, but could later regret having been too open (Welman, Kruger & Mitchell, 2005).

#### *3.2.2.3 Anonymity and confidentiality*

Anonymity means the identities of those taking part not being known to anyone except the researcher. This might be compromised if participation is arranged by or through a third party (an employer or organisation - as in the case of some interviews in this study) or in case studies or other designs where there are structural linkages between samples. In these cases, absolute guarantees of anonymity cannot be given and the participants should be made aware of who will know of their participation (Veal, 2005).Confidentiality means avoiding the attribution of comments, in reports or presentations, to identify participants. Both

direct attribution (comments linked to a name or a specific role) and indirect (by referring to a collection of characteristics that might identify an individual or small group) were avoided (Ritchie & Lewis, 2003).

#### *3.2.2.4 Fair treatment*

The right to fair treatment is based on the ethical principle of justice. This principle requires that people should be treated fairly, and should receive what is owed or due to them.

The selection of participants and respondents was not based on a cultural, racial, social or sexual basis, but on relevance regarding the participants' role to the research. Participants and respondents were treated fairly and with respect (Ritchie & Lewis, 2003).

#### *3.2.2.5 Rights of institutions*

The rights of institutions were safeguarded by the researcher obtaining permission from the relevant authorities. The researcher also ensured the following:

- Officials and staff were not impeded from doing their work during data collection.
- Confidentiality of data was maintained at all times.
- The research results will be made available to the institution.
- Information will be made available to all stakeholders without disclosing any particulars (Veal, 2005).

## 3.3 Research Participants

According to Sekaran (2003) purposive sampling states that instead of obtaining information from those who are most readily or conveniently available, it might sometimes become necessary to obtain information from specific target groups. The sampling here was confined to specific types of people who can provide the desired information, because they were the only ones who have it, and they conformed to criteria set by the researcher.

In line with this, the researcher conducted in-depth interviews with purposely selected planning professionals within the George Municipality who held specific knowledge on water

management (restrictions and shortages). It was important that the research be based in the respective departments so that the results will be useful in the George Municipality. Interviews were conducted in July 2014.

The selected participants were first contacted by e-mail and telephonically to request their consent to participate in an interview. The intention of the interviews was to obtain their professional opinions and for them to answer the research questions, in addition to and separate from the literature review.

### 3.4 In-depth Interviews

This data collection tool permits a deeper level of communication, allowing the researcher to access the interviewee's opinion and feelings. If the interviewee lost track of the research interest, probing questions were asked by the interviewer to stay focussed on the interview. The researcher (interviewer) made notes as a voice recorder was not used, which were later analysed by the researcher. The researcher had prepared a pre-determined list of questions (effectively an informal questionnaire) to work through during the interviews to have a clear idea of the particular aspect the researcher wanted to explore with each participant.

The researcher started by asking 14 primary questions (see Appendix A) then moved steadily into the investigation, to eventually discuss water shortages and the measures implemented to alleviate water shortages. The interviewees were asked to answer the questions as frankly as possible. The interviewer provided an overview as to the needs, the purpose of the research and the need for clear responses from the interviewees.

This allowed the interviewee to gear himself into the right state of mind by making them think about the measures implemented for the alleviation of water shortages; this provided context and the basis for further follow-up questions.

### 3.5 Analysis of Interviews

Content analysis is a special application of systematic observation of personal documents and mass media material. This may also deal with open-ended questions and the contents of in-depth interviews. It involves systematically examining the content of these sources to

record the relative incidence (frequency) of themes and the way in which these themes are portrayed (Welman, Kruger & Mitchell, 2005).

The research analysis began by identifying all the concepts mentioned by each interviewee in their responses to the interview questions, as noted by the researcher. The original stated concepts (See Appendix A) were maintained to ensure that the researcher's objectives, plus new insights, were covered in the analysis.

This was done by highlighting word repetition in the notes made by the researcher. A list of concepts from all the interviews was drawn up with the number of interviewees that individually mentioned it. A concept was eliminated if it was only mentioned by one interviewee. The results of this process are shown in Table 3.2. on the next page.

After analysing the summarised and highlighted notes, the researcher deemed concepts mentioned by more than one interviewee to be significant as a theme. According to Welman, Kruger and Mitchell (2005), themes can be described as constructs which are usually identified by the researcher before, during and after the data collection.

Themes can also be identified by reviewing the original field notes. Summaries were created for each of the themes to compare and contrast the responses of interviewees.

The interviewees' notes were rechecked throughout the process of writing this narrative to ensure that the researcher's feelings and emotions were not interfering with the interpretation of the data. The interviews were independently considered which maintained the anonymity and confidentiality of each interview.

## 3.6 Chapter Summary

This chapter outlined the rationale for the research methodology selected: qualitative research via collection and analysis of in-depth interviewers. It described the participants and interview format, the data collection and data analysis. To have a clear idea of the aspects

that the study wanted to explore the researcher designed a list of questions, or an informal questionnaire, as per Appendix A.

Analysis of the interviewee responses is presented and discussed in the next chapter.

**Table 3.2: Interview concepts, codes and themes**

| 1.Interview Sources (concepts) | 2.Codes | Themes |
|---|---|---|
| Water levels, rainfall conditions, water storage, seasonal rainfall, water demand | Primary water supply | Garden Route Dam |
| Water shortages, reduce water consumptions, drastic measures on water | lower water usage | Water restrictions strategies |
| Water saving, low water usage, maintenance and repairs | Collect water | Water saving appliances |
| Change public perception about water, educated on water | Communication | Public water awareness campaign |
| Alleviate water shortages, knowledge and understanding to support water savings | Importance of water restrictions | Water restriction mitigations |
| Water consumption, water levels deteriorating, | Basic water requirements for residents | Emergency Tariffs |
| Low rainfall, future water levels | Long-term planning | Climate Change |
| Depleting of dam levels, wasting of water, control, low volume of water, | Comply with Provincial Government | Drought Policy |
| Funds needed, maintenance of projects and campaigns | Funds Allocated | Funding and financial implications |

# CHAPTER FOUR
# DATA ANALYSIS AND RESULTS

## 4.1 Introduction

This chapter analyses the data and discusses the results. The interpretation together with the general comments which emerged from the data collection is presented below. The analysis covers the factual details of the measures put in place to alleviate the water shortages in the George municipal area and general comments on what other measures could be implemented should the situation repeat itself. It also provides results of these measures in terms of the disaster management crisis.

The data collected from the interviewees' responses were analysed by the researcher to identify concepts and codes which were grouped into themes. These themes are presented in this chapter, together with themes that were identified during the literature review.

Interviewees focussed on how the water shortages in the George municipal area started and the projects that were implemented to ease the situation (short-term and long-term strategies).

They were specific about the results or solutions of the water shortage mitigation measures that they implemented successfully, and what made them possible and effective when implemented. Overall, interviewees had strong solutions, and were optimistic that they were possible and would be effective again in a similar situation.

This chapter presents the themes in a narrative structure. This discussion starts with a broad discussion of the theme itself, followed by interpretation and summary.

## 4.2 The Garden Route Dam, Rainfall and Consumption

Interviewees confirmed that the GRD is the primary water supply for George. The sustainability of this water supply depends on seasonal (winter) rainfall to fill the dam, which accumulates to full storage in the winter months to provide for the water demand in the

municipal area. Therefore there is a tight relationship between rainfall, water consumption and the GRD levels.

Figures 2.8 to 2.10 compare the dam levels, rain and water consumption indicators across the period of the research, 2009–2011. From these it is evident that with the exception of 2011, George experienced below-average rainfall conditions during the reporting period. In 2009 the dam levels were plummeting and George was hit by a severe water shortage. Water restrictions were imposed which had to been tightened again in the same year.

The average dam level in 2009 was 44.87 per cent (Figure 2.8) but reached its worst level in 2010 (39.0 per cent) (Figure 2.8). The average dam level in 2009 and 2010 respectively did not reach 50 per cent. However, by 2011 the average dam level had recovered to 98 per cent.

Excellent rainfall conditions were experienced over the entire George municipal area in 2011. The cumulative rainfall for 2010 and 2011 clearly indicates the improved conditions. The Municipality has also commissioned a number of emergency projects and was therefore rated as having a sustainable water supply.

The George Municipality plans to raise the GRD wall and spillway. Funds have been received from National Treasury through the Eden District Disaster Management Centre for this extension after the necessary documentation for emergency disaster funding was compiled. The interviewees mentioned that this matter of the dam wall went back to 2009 when the George municipal area was declared a drought area, and regular drought management meetings took place with all relevant stakeholders.

A decision was made to continue with emergency recovery work (strategies and mitigation to alleviate water shortages) and to obtain water licenses and approval from the Department of Water Affairs to raise the GRD wall. (A water licence is required for legal, administrative and auditing purposes.)

## 4.3 Water Restriction Strategies

The dire situation meant that water consumption had to be managed to extend the life of the water resources to meet the basic water requirements for the residents of the George municipal area, and local industries.

### 4.3.1 Carting of water

George Municipality did not receive any water from neighbouring municipal areas such as the Knysna or Mossel Bay municipalities. Carting of water by water tankers from other municipal areas was not considered because of the cost implications. The goal was to manage the situation at the dam so that it did not run dry.

Despite the circumstances the municipal officials were confident of remaining independent and were optimistic about the inflow of water into the dam: interviewees recalled that there was inflow into the dam during this period although it was very limited. The researcher was struck by how positive the interviewees were when uttering these words.

### 4.3.2 Water-saving appliances and practices

The interviewees reported that a list of water saving appliances was drawn up to alert water consumers that these could be installed to lower water usage. This included installing low-flow showerheads and toilets, or replacing existing fixtures, in homes and business.

The mechanical irrigation of gardens was prohibited to save water. Further restrictions included the regulation that gardens could only be watered between 19:00 to 21:00, on certain days: even-numbered households (e.g. 2, 4, 6……) on Mondays and Thursdays, and uneven-numbered households (e.g. 1, 3, 5…) on Tuesdays and Fridays. If used, garden hoses had to be hand held.

The interviewees mentioned that water consumers were advised to collect rainwater run-off from their roofs and store it in water tanks for use in the lawn and garden. This would help the municipal area to save water and also benefit homeowners themselves.

The key focus for the Municipality was saving water at schools and the potential re-use of wastewater. Non-residential large users, for example farms and schools, have significant potential to reduce water consumption via re-use of water. It encouraged the use of water tanks to home owners, farmers and schools (as playgrounds consumed a lot of water). This was to ensure that drinking water was not used to irrigate lawns. Interviewees commented that this system functioned well: water consumers contributed to saving of drinking water by not wasting it on lawns and gardens.

Leaking pipes were also detected and repaired by the Municipality in response to complaints of this nature reported to the Municipality. The Municipality insisted that during construction processes the consultants must carry out strict monitoring of construction methods and pipe lying to ensure that the quality of the pipes network system is of a high standard. This reduced water loss during construction and will reduce future leakages and breakages which could occur if pipelines and fittings are incorrectly installed.

Pressure management was also introduced, by installing pressure-reducing valves with constant downstream pressures. Pressure reduction was implemented to lower pressure to the minimum required during peak time.

Interviewees believed the water restriction initiatives were effective and efficient because less water was lost to leaking pipes and therefore more water reached the taps. The lower the amount of water that needed to be supplied and served to water consumers, the slower the dam level dropped and the lower the risk of the dam running dry.

These measures prove that the water demand management strategy was implemented successfully by the Municipality. The strategy has helped the Municipality to achieve water sustainability, and a drastic drop in their in their total bulk water demand over the last three years (Human, 2013b). This confirms that overall water usage reduction has been implemented to the maximum.

### 4.3.3 Public awareness campaign

According to Low (2005) capacity building needs in education, training and raising awareness include the public at large.

The interviewees concurred that the public awareness campaign was a very important − indeed critical − aspect in the implementation of the water restrictions and was intensified during the period as the situation worsened: dam levels were dropping very fast and water consumers had to be educated on how to save water. The intention of this campaign was to reduce consumption to a level that prevented further, more drastic, measures.

All possible ways of communication were used, including radio, press, television, billboards, posters, and announcements in the streets (see Section 2.10 above). The public was made aware physically and mentally regarding the water crisis, the water restrictions and water consumption patterns and was involved in an on-going water conversation.

The interviewees were thankful for the role the local media played in this strategy and noted the tremendously positive response from the public. Overall they had a very positive attitude towards the implementation of the public awareness campaign and felt it had been successful and showed optimistic results.

Water consumption decreased by 38 per cent from April 2009 to the beginning of 2010 which was testimony that the awareness campaign contributed positively to the management of the water shortage in George. Even now, at the time of writing in 2014, it is evident that although the municipal area has recovered completely from the water shortages it is still encouraging the public to be mindful of what was experienced in the past and to save water continuously.

Interviewees reported that the following measures were in place to change public perception about water use:

#### *4.3.3.1 Radio ad campaign with Eden FM*

This involved a 5-7 minute competition every morning regarding water awareness. These competitions alerted people and rewarded the listeners. Jingles relating to wise water use were flighted throughout the day. Different water or municipal experts were given the use of an hour or half-hour slot twice a week.

#### *4.3.3.2 Billboards*

These were erected at the entrances to the region. Individual towns erected their own billboards and banners as they saw fit.

#### *4.3.3.3 Newspaper advertising*

Newspaper adverts regarding water restrictions were placed in the following newspapers on a regular basis:

- The George Herald;
- Die Son; and
- Die Burger.

#### *4.3.3.4 Promotional items and giveaways items to create awareness*

- T-shirts, bumper stickers, mouse pads, license disc stickers.
- Signage regarding the drought erected at the George Airport.

#### *4.3.3.5 Social marketing*

Interviewees noted that an aggressive social marketing awareness campaign was conducted at the community level which was about connecting with individuals, residents and neighbours. This included community events to promote water conservation, for example road shows. Educational material (e.g. pamphlets and guides on saving water in homes) was made available and distributed widely in the communities throughout the George municipal area.

Collectively all these measures educated the public area about the water crisis. Interviewees noted that there was a great deal of convincing to do in the George municipal area about the importance of saving water, because often the public did not have an understanding of how much water they use and how valuable it is. Mass public education was needed to change public perceptions and personal behaviours toward water conversation.

Therefore the education included information about water shortages, water restrictions, water conservation and the effectiveness thereof. It helped individuals to realise their personal effect on the water shortages and to understand the measures implemented to alleviate water restrictions.

### 4.3.4 Planned future interventions

One of the future water demand measures to be implemented by George Municipality is to include the installation of low-flow showers heads, and dual-flush, low-flow toilet cisterns (Human, 2013a).

Other measures, for example a desalination plant, would also help to reduce water shortages in the George municipal area.

Feldman (2012) notes that an area where water stress is highest is in urban areas composed of millions of people. It is likely that we will see more fresh water conflicts in the future. Such conflicts are also touchstones for innovations in conservation, waste water re-use and recycling and desalination.

## 4.4 Water Restriction Mitigations

Interviewees were able to provide a host of advice about how to implement successfully water restrictions measures to alleviate water shortages. They believed that knowledge and understanding of the importance of water restrictions contribute to water conservation.

### 4.4.1 “Simplistic” methods

Interviewees deemed as a very significant first step were the so-called “simplistic” methods and small changes to save water. Some water restriction implementation plans took a longer time to materialise before seeing results, as they required tough or costly decisions or were difficult to implement. However there were many other approaches that could achieved significant results in a relatively short period of time and were easy to implement.

First, the implementation of water restriction plans with relatively “simplistic” methods created fast results with significant increase of creditability of the efficacy of the plans and confirmed the benefits of water conservation to those who would otherwise not support it. This provided motivation for continued adherence and for the more difficult and long-term plans (e.g. raising the GRD wall) required to achieve true sustainability.

Second, it was normal that most people did not want to change their behaviour and habits. George Municipality had some difficulty in convincing these types of water consumers, especially those who were set in their ways. Interviewees noted that water consumers with high consumption were the most difficult to break of their habits.

These water consumers are so used to abusing water that it was second nature not to think about their water usage. An example is when men are shaving and leave the tap running when rinsing their razor. The use of grey water, also called recycled water, was suggested to households as a potential way to recycle water for household use but not as drinking water.

Harding (2011) lists how grey water can be used for other purposes instead of wasting valuable drinking water on these. Therefore the use of grey water as a contribution to saving water is a water restriction mitigation.

### 4.4.2 Push-type taps

The Municipality had little control over water use in the informal settlements but developed an initiative to reduce water losses in these areas by the means of push-type taps. These taps are designed to close automatically. A knob on the tap needs to be depressed by hand

for water to flow out. When the knob is released it shoots back and the water stops flowing. Residents in informal settlements are not liable for water accounts and they were nonchalant about water losses in the area. The perception of the right to water, per the Constitution, leads many people to think that they have the entitlement, or right, to use and waste as much water as they want. This attitude needed to be changed.

### 4.4.3 Emergency tariffs

George Municipality employed emergency tariffs to address the water crisis to mitigate the impact of the disaster. This took the form of a progressive water tariff that increased for blocks of water usage.

Emergency tariffs were implemented to prevent the water levels from deteriorating even further. The George Municipal Council decided on stringent measures when the dam level was depleted to 25 per cent and the adjusted the tariffs upwards. For householders water usage over 15 kilolitres per month was charged at an emergency rate of double the normal rate, a triple emergency tariff for consuming more than 30 kilolitres per month and five-times more for more than 50 kilolitres consumption per month.

All other tariff groups (car washes, dry cleaners, industries with consumption greater than 100 kilolitres per day, farms/rural areas, educational institutions, welfare organisations, religious institutions and municipal buildings) were subject to an increase of an additional fifty per cent for their usage.

It was planned that should the GRD reach a level of 15 per cent then the minimum usage of water consumption will be reduced to 10 kilolitres per month. This upward adjustment of water tariffs also accommodated the impending shortfall in budgeted revenue from water consumers and promoted financial sustainability in this time of severe shortages.

This mechanism worked very well to manage the consumption of water. The heaviest water users would be penalised and lower water users would be rewarded, thus creating an incentive for water consumers to use less water. Human (2013a) notes that the necessary

Water Services Bylaws for managing the water and sanitation services were in place, which enabled the introduction of the new tariffs.

### 4.5 Climate Change

Interviewees discussed this in terms of conducting long-term planning for water restriction and consumption in George, and adapting to the potential effects of future climate change (see Section 2.8.3 above). According to the interviewees it is believed that the George municipal area is likely to have longer, drier summers in the future. An overall decrease in rainfall is not forecasted for 2014.

Should water shortages occur again and result in a drought; the measures set in place to alleviate water shortages will mitigate the likelihood or severity of water restrictions in the future.

The interviewees mentioned that the measures were fully incorporated into the long-term Water Master Plan and Water Demand Management Strategy. These give the Municipality the means to take a more holistic and comprehensive approach on water shortages.

### 4.6 Drought Policy

The interviewees explained that water restrictions were implemented in April 2009 in terms of a council resolution that restrictions would be imposed if the GRD level reached 60 per cent. The restrictions were intensified on three occasions in 2009 and a decision was taken to implement emergency tariffs when the volume of water in the dam reached 25 per cent.

Mr Anton Bredell, then Provincial Minister for Local Government, Environment Affairs and Development Planning, had requested the George Municipality to draw up a drought policy that indicated specific measures to be taken when water resources (of dams and rivers) dropped to certain levels. This was approved by council on 25 November 2010.

George Municipality therefore had – and has – a Drought Management Policy in place to manage possible future drought or water restriction situations, periods of low rainfall, or insufficient raw water resources, to address the needs of the residents of George.

Most of the water restrictions items discussed above are covered in this policy. The Municipality also adhered and complied with the requirements of the Western Cape Provincial Government in adopting this policy.

The Municipality achieved a drastic drop in consumption over the 2009-2011 water shortage periods, thus confirming that the drought policy reduced the level of the shortfalls in the supply of water.

### 4.7 Funding and Financial Implications of the Water Shortage

Interviewees described how the EDM allocated funds towards the drought mitigation projects and mentioned that the measures implemented to alleviate water shortages were priority for the George Municipality.

However funding for the water shortage strategies and mitigations was a concern. Maintaining the awareness campaign and emergency projects financially was important because of limited municipal budget. These water awareness campaigns and projects had to be as efficient as possible to get the maximum benefits and had to find sources of funding whenever possible.

Funds were provided by the EDM for certain projects, for example emergency sinking of new boreholes and research on the feasibility of a desalination plant. This confirms that the EDM and George Municipality worked together to provide funding for water shortage projects. The total cost of the funds was allocated toward the projects with a shortfall of funds still remaining. The shortfall of funds was financed from savings on the existing capital budget and external loans in the financial year 2009/10.

Another impact of the water restrictions was the resultant lower water sales which reduced water income for the financial year. This shortfall, as well as the resultant cost of the loans, was financed from the higher water emergency tariffs. The George Municipal Council approved both taking up the loans and the adjustment of tariffs in the financial year.

The financial implications of the drought disaster were thus kept under control through the joint actions of the National and Provincial Treasuries and the local authority (George Municipality). The Municipality had capital savings to contribute to the disaster and also an external loan to settle the shortfall.

However interviewees expressed concern that the community had to carry the burden of higher tariffs to pay for the external loan that was taken up by the Municipality. This shows genuine commitment to serving the community and that that they are not at the Municipality only to earn a salary.

## 4.8 Chapter Summary

The objective of the research was to assess how effective and efficient water restriction measures in place were in alleviating and mitigating the water shortages experienced in the George municipal area during the worst drought in over 100 years. The specific objectives of the research were to assess implementation and measures that were put in place to reduce the demand for water.

The George Municipality needed to keep itself abreast of the drought policy and practices that informed to water restrictions. The basis of the water restrictions and their management increased knowledge in the departments responsible for their implementation, thereby contributing to institutional capacity.

The departments, namely the Civil Engineering Services: Water and Sanitation Services and Disaster Management Services, made the most out of the funds that were available for the alleviation of the water shortages. This allowed them to conduct more water restriction activities. Water restrictions have equal status in planning as building new water supply infrastructure, for example the raising of the GRD wall.

A wide variety of water restriction implementation plans, awareness campaigns, emergency tariffs, and funding of water conservation measures added to the complexity of the water shortage. Increased participation of water consumers in the water saving awareness campaign and the plans for the alleviation of the water shortage promoted the likelihood of success. This increased the knowledge-base in the local community and should reduce conflict against water restrictions should they be necessary in future.

The water restriction implementation plans can be used in the greater Eden district and neighbouring municipal areas, with potential for great success.

In the next chapter final conclusions are drawn and recommendations are made.

# CHAPTER FIVE
# DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Introduction

George endured a drought of disaster proportions in 2009–2010. This chapter concludes the study by presenting discussion on the findings and suggestions arising from the research process, providing recommendations with regard to the measures to alleviate water shortages in the George municipal area.

The interpretation of the findings was to assess effectiveness and efficiency of the implementation of water restriction measures, and assess the intervention strategies and mitigations regarding the water shortages. Collectively these measures strengthened the Civil Engineering Services: Water and Sanitation department in the George Municipality and made water consumers more aware of water shortages, restrictions, and the need for water conservation.

In doing so, the George municipal area's water supply has become more efficient, effective and sustainable for future generations.

## 5.2 Discussion

George Municipality introduced interventions, strategies and mitigations for periods of water shortages. During the 2009-2010 drought the three spheres of government (national, provincial and local) had to work together to address the situation. A great deal of effort was required to change community perceptions and behaviours to effect the necessary reduction in water consumption to protect the community water supply.

The implementation of the mitigation measures and strategies was intended to ensure the dam didn't run dry, so that people had drinking water and businesses and industries could operate. Successfully effecting these measures also resulted in the capacitation and strengthening of the municipal Civil Engineering Services: Water and Sanitation Services and Disaster Management Services

The George Municipality remained positive and continued to implement new strategies in the belief that the situation was amenable to improvement. This study posits that such issues are capable of management, that difficult issues can be resolved and that there are many ways to resolve them. Some actions or activities that were implemented almost hampered water sustainability (e.g. the behaviour of difficult water consumers) but overall the objective of reduced consumption was met.

The assessment has proven that a number of the short-term strategies that were implemented provided a significant reduction in overall water usage. These solutions include the so-called “simplistic” interventions such as water leak detection and repair, introduction of emergency tariffs and water restrictions.

These types of solutions worked because they required little effort from water consumers. Thy provided acceptability to water restriction programs and were a good place to start towards building sustainability of the water supply. They were applied equally to the community and businesses and achieved their greatest effects when the Municipality worked closely with water consumers to reduce water consumption. The Municipality provided supportive assistance to water consumers on how to reduce water usage in general.

Community-based social marketing focused the public’s attention on water conservation by explaining how water is used and why it is needed in the first place. Marketing “personalised” water restrictions to homeowners and businesses, which showed how using less water would decrease their water bill and therefore the impact of the emergency tariffs, helped to minimise water consumption.

The water restrictions will help reduce the impact of water shortages in the future because the George Municipality is more prepared for future uncertainties, including climate change. If climate change causes future water shortages, it will be less difficult to safeguard the water supply before a crisis reoccurs.

A successful water awareness campaign required dedication by the respective departments. They regularly monitor and evaluate the water supply indicators and situation to be able to

provide up-to-date data and give informed opinion and effective detail to decision makers. The municipal department has an optimistic outlook on water shortages.

It is important to stress to the Municipality that implementing water restriction measures to reduce consumption as a means of counteracting water shortages does not mean limiting future population and economic growth. These contribute to the sustainable economic and social benefits of the George municipal area. The measures set in place to alleviate the water shortages were powerful motivators for continuing reduced consumption, with tangible results even after the crisis was over.

In particular the re-use of grey water and rainwater collection by homeowners has reduced water usage and so contributed to the saving of water. Changing the way that individuals think about and use water is a difficult task because perceptions and habits are often traditional; nevertheless this was successfully accomplished in many communities.

Finally, selling water for revenue gain is a short-sighted strategy. Increasing water shortages in the future may require more expensive infrastructure and water consumption efforts.

## 5.3 Conclusions

The research problem encompassed the assessment of the shortage of water and the strategies and inventions set in place, in November 2009, to alleviate the water shortage. The particular focus of the study was on the implementation of the strategies.

A clear strategy was developed for this research. Chapter One addressed the research background, by providing an introduction, statement of the problem and rationale for the study. The research objectives, research questions, significance of the study, literature review, research methodology, data collection, data analysis, ethical considerations, the organisation of the study, and definitions of concepts were briefly outlined.

In Chapter Two a theoretical and legislative overview of the water shortage and measures implemented in George was presented. This chapter contained a review of literature related

to water in general. It also highlighted the challenges of water shortages and measures implemented to alleviate water shortages in the George municipal area.

The literature review provided an overview of the available literature at a national, provincial, and local level, and at municipal level in particular. The water shortages were the most severe experience in over the past 132 years.

Chapter Three discussed the research methodology employed in this study. It provided an outline of the research methods and the selected participants. In-depth interviews were used as the primary research instrument.

The results of the interviews were collated and analysed in Chapter Four. It presented the research findings and was accompanied by interpretations by the interviewees of the water crisis and interventions addressed in this investigation. An analysis of the measures implemented to alleviate the water shortages was also provided in this chapter.

The findings revealed that the measures implemented to counteract the water shortages were positive in the municipal area. The assessment indicates that not only did they mitigate the impact of the disaster, but has placed the Municipality in a position to have a strategic, futuristic outlook should this natural disaster reoccur.

The intention was to reduce water consumption to a level that would prevent further, more drastic, measures for as long as possible. The role of the local media was particularly highlighted in that it had a tremendously positive response from the public. Regarding the methods used, the findings revealed that “simplistic” interventions helped reduce water consumption, but these do not prevent the Municipality from exploring other improvement avenues such as desalination.

## 5.4 Recommendations

The study forwards the following recommendations, made against the fact that the Municipality did not have sufficient funds to implement all that was planned, for example the desalination plant.

### 5.4.1 Public awareness campaign

The George Municipality continues to market water awareness to the public even though the George municipal area is no longer experiencing water shortages. This task should continue to be managed by the Senior Manager: Water Services and Sanitation, which is the coordinating department of this process.

Marketing or advertising could occur on a quarterly or bi-annually basis and on social media, local radio, billboards and in the local newspaper, as a friendly reminder to respect water, its consumption and conservation.

### 5.4.2 Drought policy

The George Municipality reviews the Drought Policy on an annual basis to ensure it remains relevant to the changing population growth, climate change, water consumption, water needs and dynamics in the George municipal area.

This must be reviewed by the Chief Financial Officer, Senior Management and the Council of the George Municipality, in conjunction with the relevant legislation and regulatory framework, for example the Municipal Financial Management Act (MFMA).

### 5.4.3 Short- and long-term water restrictions and mitigations

The George Municipality rolls out short-term water restriction strategies and mitigations, for example the “simplistic” methods, in concert with the implementation of long-term water restriction strategies and mitigations, such as the raising the GRD wall. Thus while the short-term strategies and mitigations are working to reduce water consumption, the long-term strategies and mitigations should work on sustaining and growing the water supply.

This indicates that the Senior Manager and the Water Marketing Coordinator in the Water and Sanitation Department should work closely together ensure the fulfilment of the common goals of saving water, collecting water and making more water available to more water users.

### 5.4.4 Water evolution resources

Taking into account the likely impact of climate change, the George Municipality installs the proposed desalination plant for the evolution of water resources as soon as funding becomes available.

Desalinated water is an alternative for solving the problem of fresh water demand. This desalination plant could be constructed at the Victoria Bay beach which is situated nearest to the George municipal area. It becomes a real alternative when fresh water is an expensive local commodity because of to the cost of making it available, or due to market competition when it is scarce, as indicated in this study.

Sourcing the funding and coordinating the development of the installation should be the task of the Director: Water and Sanitation, Civil Engineering Services. It already has a number of studies on the need for the installation based on climate change and other variables.

The Municipality should develop a business plan to receive funding from stakeholders, including the National and Provincial Treasuries, the Department of Water Affairs and private institutions and banks. This would prevent the George Municipality from raising an external loan and placing a financial burden on rate payers.

### 5.4.5 Strategies for high water consumers

The George Municipality should monitor and estimate future changes to the water consumption patterns by business and agriculture, the largest water users. The Civil Engineering Services: Water and Sanitation Services department should analyse, monitor and evaluate the use of water by this type of water consumer. This will give the Municipality a clear indication of how to target groups that consume high volumes of water, to best estimate their consumption of water and potential for water revenue generation.

An in-depth study of each large water user needs to be conducted to provide detail towards potential wastewater treatment technologies, cost of treatment and sustainability. The Municipality needs to look at providing incentives to water users to allow for such an investigation.

### 5.4.6 Relationships with water experts

The George Municipality should continue to build relationships with water experts, for example Ninham Shand (Aurecon), for bulk water planning and the establishment of an early warning system against water scarcity, as mentioned in this study.

Therefore it is recommended that the Senior Manager of the Water Department should concentrate on risks (delay in water projects) and early warning signals (climate change) for water shortage conditions. The Senior Manager of the Water Department should continue to strengthen the alignment of the water management strategies to climate change, as discussed in this study.

## 5.5 Area for future research

The research can be expanded by drawing a pool of respondents from the community to corroborate the views expressed by officials around water shortage inventions. Due to the time and financial constraints experienced by the researcher, the community could not be interviewed when this particular study was conducted.

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# APPENDICES

## APPENDIX A: INTERVIEW QUESTIONS (IN-DEPTH INTERVIEWS)

1. What was the extent of the water shortage in 2009-2011?
2. What was the plan to prevent further water shortages?
3. What types of awareness campaigns were implemented?
4. Why was George in a water crisis and could it have been prevented?
5. What was the impact of climate change and how was provision made for this in the planning of water resources?
6. What was the potential water resource planning?
7. How was larger development accommodated?
8. How was dam volume tested?
9. Why were water restrictions not implemented earlier?
10. At what stage will the Municipality restrict the flow of water to different areas?
11. What experiences or challenges did the Municipality face with the implementation of the measures set in place for the water shortages?
12. What was the performance of the measures set in place in the George municipal area? Negative or positive?
13. What is the current *status quo* of the water consumption in the George municipality area?
14. How is the Municipality ready for any future potential drought(s)?

## APPENDIX B: LETTER OF PERMISSION

G E O R G E

MUNISIPALITEIT UMASIPALA WASE MUNICIPALITY

*VERW/REF:*

*NAVRAE:* **H Jansen**

*ENQUIRIES:*

*TEL:* **(044) 801 9357**

TO WHOM IT CONCERNS

21 February 2014

Sir/Madam

**RESEARCH : WESLEY BAATJIES**
**MASTER STUDENT FROM CPUT, CAPE TOWN**

With regards to the abovementioned, we confirm that we herewith approve Mr Baatjies to receive the necessary information from the George Municipality to complete his thesis on Water Management and that the information was given to him.

We trust you find this in order.

Yours faithfully,

HAROLD BASSON
**DIRECTOR: CIVIL ENGINEERING SERVICES**

## APPENDIX C: DECLARATION OF LOCAL DISASTER: GEORGE MUNICIPALITY

PROVINCE OF WESTERN CAPE

PROVINSIE WES-KAAP

# ProvincialGazette

# Provinsiale Koerant

6677

6677

Friday, 20November 2009

Vrydag, 20 November 2009

**TEXT EXTRACTED**

P.N. 435/2009 20 November 2009

**GEORGE MUNICIPALITY**

DECLARATION OF A LOCAL DISASTER

Notice is hereby given in terms of section 55(1) of the Disaster Management Act, 2002 (Act 57 of 2002) that the George Municipality, in consultation with the National-, Provincial- and Municipal Disaster Management Centres, on 06 November 2009, resolved that due to the current drought conditions in the jurisdiction area of the George Municipality, the Municipal area be declared as a local state of disaster in terms of the said Act.

The National Disaster Management Centre endorsed the classification of the George Municipality by classifying the drought as a local disaster in terms of Section 23 (1) (b) of the said Act on 10 November 2009.

CM AFRICA, MUNICIPAL MANAGER

P.K. 435/2009 20 November 2009

**GEORGE MUNISIPALITEIT**

AFKONDIGING VAN 'N PLAASLIKE RAMP

Kennis geskied hiermee ingevolge artikel 55(1) van die Rampbestuurswet, 2002 (Wet 57 van 2002) dat die George Munisipaliteit, in oorleg met die Nasionale-, Provinsiale- en Plaaslike Rampbestuursentrums op 06 November 2009, besluit het dat, as gevolg van die huidige droogte in die Munisipaliteit se jurisdiksiegebied, die Munisipaliteit as 'n plaaslike rampgebied ingevolge die gemelde Wet verklaar word.

Die Nasionale Rampbestuursentrum het die klassifikasie van die George Munisipaliteit ondersteun deur die droogte as 'n plaaslike ramp ingevolge Artikel 23 (1) (b) van die gemelde Wet te verklaar op 10 November 2009.

CM AFRICA, MUNISIPALE BESTUURDER