Water management in the wildlife lodge industry: A multiple case study in South Africa, Namibia and Botswana.

By

Jacobus Johannes Grobler

Submitted in accordance with the requirements for the degree

Master of Science in Environmental Management

In the

College of Agriculture and Environmental Sciences

Department of Environmental Science

at the

University of South Africa

Florida Campus

Supervisor: Prof. K. Mearns

February 2018

Declaration

I, Jacobus Johannes Grobler, student number: 50963708, hereby declare that this dissertation which I hereby submit for the degree of Master of Science in Environmental Management for the College of Agriculture and Environmental Science (CAES) at the University of South Africa (UNISA), contains a literature survey and original research that is my own and that this dissertation has not previously been submitted by myself for a degree at this or any other institution.

All the information in this dissertation has been obtained and presented in accordance with the institution's rules and ethical conduct. I declare that all information, figures, tables and graphs obtained from existing literature has been acknowledged through citations and referencing.

I declare that no material from the internet were copied and pasted in this document.
I declare that the content of my dissertation has been submitted through an electronic plagiarism detection program before final submission for examination

Student Signature Date: 14 February 2018

Acknowledgements

I would like to acknowledge the following people and organisations who contributed and supported me vastly throughout the duration of this study resulting in the completion of the study:

- Firstly I would like to thank my wife, Alieke and children, Janco and Lia, for supporting and encouraging me from start to finish and allowing me the time away from them to complete this study.
- Prof. Kevin Mearns, my supervisor, for all his time, guidance, expert advice and support during the study. It has been an amazing journey working with Prof and without your assistance this would never have been possible.
- &Beyond management, staff and especially Mr. Jonathan Braack, &Beyond group sustainability manager. Thank you for your hospitality at your lodges and the data you availed for this study. Without your inputs this study would not have been possible.
- Wilderness Safaris management, staff and especially Mr Warren Ozorio, group environmental coordinator. Thank you for arranging all the logistics for our camp visits and availing your data for this study. Ms Segametsi Monnamorwa for hosting us at the lodges and ensuring that I obtained all the data I required to complete this study.
- I would also to thank UNISA for providing me with the opportunity to study, the financial aid through the bursary and all the staff at the CAES who played a part for me to have reached this goal.

Abstract

Water is life, and without it nothing can survive. All plants and animals need water to survive, whether it is fresh or salty. Climate change and pollution contribute greatly to the decline of freshwater supply and quality (National Geographic, 2015). According to the United Nations, 10% of the global population does not have access to clean water (UN Water, 2016) while World Health Organisation (WHO, 2009) stated that 3,4 million people die annually from water related diseases.

The tourism industry across the world requires water for basic human consumption, irrigation of gardens and golf courses, preparation of food and drinks, making snow for winter sports and general water activities such as swimming or motorised water sports (Gössling *et al*., 2012). Many tourism lodges in the wildlife lodge industry in South Africa, Namibia and Botswana are in remote areas where little or no infrastructure exist. These lodges are dependent on natural water sources such as rivers, dams and boreholes to supply their water demand.

The main objectives of the study were to determine water quality and quantity management in lodges from South Africa, Namibia and Botswana. The objectives were divided into sub-categories such as frequency and comprehensiveness of water quality analysis, the current quality of water at each lodge, water consumption per capita, establish benchmarks for the lodges and investigated other management components such as stakeholder involvement, financial implications and the monitoring of water management systems

Across all three countries, 29% of the lodges have tested the water quality of their source, 61% tested water quality on their taps and 19% tested water quality of their wastewater discharge. From the 61% that did water quality tests on their tap, only 11% tested more than 37% of the required parameters as stated in the countries relevant standards and guidelines. The results indicated that the average water consumption across all three countries were 2073 l/g/n or 503 l/b/n when staff is included. Strong correlations were established between water consumption, the guest to staff ratio and rate in US $ when all three countries were considered. The water quality results indicated that several lodges had issues with Iron, Sulphate and Chloride levels.

The author concluded that the current water management systems can be improved to ensure that water quality is managed more sustainably in the wildlife industry. The biggest concern relates to wastewater discharge, where very few water quality analysis are done. This has the potential to cause pollution and degrade ecosystems. It was recommended that more frequent and more comprehensive water quality analysis must be carried out on wastewater discharge as well as tap water to ensure water is safe for consumption. Lodge managers can appoint designated personnel to ensure that water meter readings are taken monthly and that they are probably recorded. The use of modern equipment such as pulse meters will prevent meters from seizing. Smart meters can be used to upload data to a cloud where WIFI is available.

Keywords

Water management, wildlife lodge industry, tourism

Abbreviations

ANOVA	Analyses of Variations
BOP	Best Operation Practices
BOS	Botswana Bureau of Standards
CAES	College of Agriculture and Environmental Science (UNISA)
CC Africa	Conservation Corporation Africa
CFU	Coli Forming Unit
COD	Chemical oxygen demand
DWAF	Department of Water Affairs and Forestry
EMS	Environmental Management System
GEMS	Group Environmental Minimum Standards
GKNP	Greater Kruger National Park
IPCC	Intergovernmental Panel on Climate Change
ITP	International Tourism Partnership.
l/b/n	Litre per bed per night
l/g/n	Litre per guest per night
OHSA	Occupational Health and Safety Act
RCAT	Root Cause Analysis Technique
RSA	Republic of South Africa
SABS	South African Bureau of Standards
SADC	Southern Africa Developing Community
SANS	South African National Standard
TDS	Total Dissolved Solids
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNISA	University of South Africa
UV	Ultra Violet

Table of Contents

List of Figures

List of Tables

Appendices

1. Introduction

1.1 Background information

"*When the well's dry, we know the worth of water*" (Franklin, 1746). This was the aphorism published by Benjamin Franklin in 1746 from his Poor Richard's almanac. Since then, the world population increased from an estimate 706 million to 7,6 billion in 2017, raising the demand for water immensely. A common saying recently is: "*you can't wash dirty water*", while Ismail Serageldin, president of the World Bank (1992 -2000) stated in 1995 at a conference in Stockholm, Sweden: "*The wars of the 21st century will be fought over water*" (Serageldin, 2009).

The first statement from Franklin was more than 250 years ago, which indicates that concerns about water resources are not a new thing, and while the human population and demand for water keep increasing, the supply and quality of freshwater are decreasing rapidly on a global scale. According to the United Nations (UN Water, 2016), 10% of the global population does not have access to clean water and almost 30% do not have access to adequate sanitation, resulting in six to eight million water related fatalities across the globe annually. Should these figures increase, Serageldin's statement might suggest that the war for water may be imminent. Although the tourism industry only accounts for about 1% of the global water consumption, it is an industry that is dependent on water for its existence.

The tourism industry across the world requires water for basic human consumption, irrigation of gardens and golf courses, preparation of food and drinks, making snow for winter sports and general water activities such as swimming or motorised water sports (Gössling, Peeters, Hall, Ceron, Dubois, Lehmann and Scot, 2012). It is of utmost importance that tourism ventures improve their water management and maximise the water available to them. The wildlife lodge industry in South Africa, Namibia and Botswana are no different and depend on water for their existence.

Many tourism lodges in the wildlife lodge industry in South Africa, Namibia and Botswana are in remote areas where little to no infrastructure exist. These lodges are dependent on natural water sources such as rivers, dams and boreholes to supply their water demand. Another significant aspect of the lodges is that staff have to reside on the property due to the lack of nearby housing, roads and public transport. Residing staff add strain on water resources, especially in water scarce areas such as the Namib and Kalahari deserts. Another challenge for the lodges is that residing staff have to use the water for domestic purposes and therefor managers have to ensure that the water quality is of such a standard that staff do not develop any health issues. Water management in the wildlife lodge industry is one of the most important, if not the most important component of the industry as it cannot operate without water.

Water management in the wildlife lodge industry involves all the processes and procedures from the abstraction point to discharging back into the environment. This will include the volume of water, quality of the water, purification systems, reticulation systems, water recycling, sewage treatment and finally discharging back into the environment. Volume plays a major role in water management at the lodges since some lodges share their water source with local communities. Depleting the source or causing the decline of the source's quality can lead to local uprisings and can cause major damage to lodge operations or the ventures' corporate image. One of the problems that the lodges face is that international guidelines and benchmarks of sustainable volumes cannot be applied to the wildlife lodge industry due to the fact that staff are residing on the property (Baker & Mearns, 2015). Another challenge is access to laboratories to conduct frequent water quality analyses. The logistical challenges to do water quality analyses raises the cost of water testing and also consume human resources to do so (W. Ozorio, Personal communication, February 12, 2017). Since the lodges source their water from natural resources, water has to be treated before it can be utilised by staff or guests. One of the challenges lodges face is that water is not fit for human consumption in certain regions even after treatment and alternative measures such as carting in water from a different location is required. Another concern is that water is discharged into the environment without knowing the quality due to the logistical challenges and the effect the water might have on the environment.

In this study the author investigated the current water management systems that were implemented at the lodges. The author determined the frequency and significance of water quality testing, the frequency and accuracy of water quantity measurement, analysed the physical quality of the water at the lodges and developed baselines and benchmarks for water consumption as well as analysed the results. The author also considered other management factors such as stakeholder involvement, financial implications and monitoring procedures the lodges implement. The author made recommendations in the water management systems which would lead to continuous improvement of current systems.

1.2 Rationale

Hanjra and Qureshi (2009) proved that water supply reached a global crisis due to increase in population and estimate that food supply will not be able to achieve the demand by 2050. Hanjra and Qureshi (2009) further proved that climate change as well as pollution is decreasing good quality freshwater supply. Gössling *et al.* (2012) indicated that water use in tourism is less than 1% of the global consumption but stated that it is advisable for water scarce destinations to engage in proactive water management systems. Becken (2014) indicated that water use in tourism in certain countries is much higher than that of local communities and that a decrease in freshwater supply can lead to conflict between tourism ventures and local communities.

Gössling *et al*. (2015) and Mearns and Grobler (2016) stipulated the importance of baselines and benchmarks to improve water management and to assist tourism ventures to use water sustainably. The latter authors also concluded that international standards cannot be applied in Southern Africa due to the difference in nature of the tourism sector and the role staff play in water consumption and management. Therefore, the researcher found it necessary to investigate water management in the wildlife lodge industry in South Africa, Namibia and Botswana.

1.3 Problem statement

The increasing demand for good quality freshwater is inducing the risk of conflict between local communities and tourism ventures, as well the risk of depleting natural water sources resulting in the ceasing of tourism operations. In Southern Africa there has been limited investigations into water management and associated managing strategies such as baselines and benchmarks and organisations have no guidelines to measure themselves against (Mearns & Grobler, 2015). International standards are irrelevant for tourism ventures in Southern Africa due to the different configuration regarding staff. Water management in the industry is of utmost importance as poor management can impact negatively on human health, the environment, neighbouring communities and business operations. Lodges in the wildlife lodge industry are generally located in remote, undeveloped areas. In contrast with hotels in urban and semi-urban areas, lodges need to source their water from natural sources such as rivers, dams and groundwater, whereas hotels in developed areas are serviced through municipal supply. Water management for the lodges thus becomes more intensive and more important since supply is self-sourced and maintained.

1.4 Aims and objectives

The aim of the study was to investigate the current water management systems lodges in the wildlife lodge industry in South Africa, Namibia and Botswana are currently implementing and to identify gaps in the current water management systems to improve their current systems. Moreover, study aimed to develop a baseline assessment and guideline of water consumption and to provide benchmarks for the lodges to improve their water management.

The objectives of the study were:

- To determine the frequency and significance water quality testing.
- To determine frequency and accuracy of water quantity measuring.
- Measure water quality results against applicable legislation
- Develop baselines and benchmarks for lodges in South Africa, Namibia and Botswana

- Investigate other management components such as stakeholder involvement, financial implications and monitoring of water management systems.
- Provide recommendations that will lead to continuous improvement.

1.5 Flow of the study

The study followed a structured flow which focussed on water management with regards to water quality and quantity, and the associated management systems. The author started off by determining if water quality is tested at the lodges and the frequency there of. The next part focussed on whether water quantity is measured as well as the frequency it is done. The author then analysed water quality reports and the results were measured against the relevant country's standard or guideline. The consumption results were then analysed to develop baselines and benchmarks. Other management components such as stakeholder involvement were identified as well as their level of involvement were investigated. Financial implications and monitoring of systems were also addressed in this study. The author concluded the study by synthesising the results, formulated applicable recommendations and summarised the study in the conclusion.

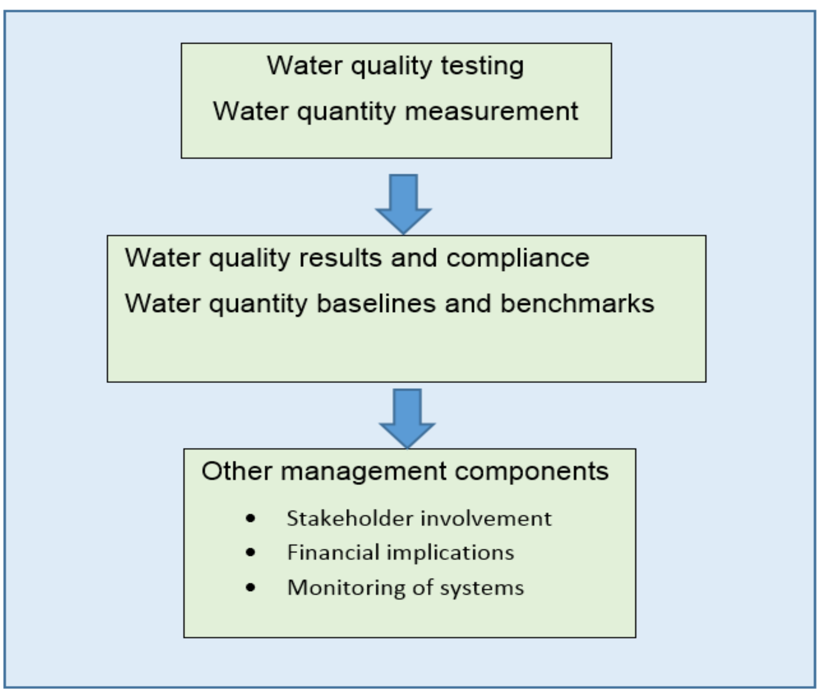

Figure 1.1 Flow of study

1.6 Chapter breakdown

Chapter 1: Introduction

In this chapter the author provided background information on the current global decline of freshwater supply. The author also highlighted the role water management plays in the tourism industry as well as indicated some risks involved in poor water management with regards to water quality and quantity. The rationale for the study was explained and current problems relating to water management at the lodges were identified. The aims and objectives of the study were also specified and defined to provide a clear understanding of the expected outcomes from the study. The author also detailed the chapters as well as the flow of the study.

Chapter 2: Literature review

The first section of the literature review focussed on the importance of proper water management and identified impacts poor water management can have on human health, eco-systems, local communities as well as business operations. The second part focussed on existing water management systems and provided the criteria the author used to investigate water management in the wildlife lodge industry in South Africa, Namibia and Botswana. This chapter also provided comparable literature and provided the framework and guidance for the methodology that the author implemented. The last part of the literature review stated future challenges and problems that might occur due to climate change, population growth, more strict legislation and regulation as well as possible increases in water cost and purification methods.

Chapter 3: Study area, organisations, design and methodology

In this chapter the author defined the study area and differentiated between water rich and water poor areas. The author also provided information about the organisations that were involved in the study and provided a map of the locations of the lodges from the organisations. The author also explained the design of the research and explained the methodology that was applied to investigate water management.

Chapter 4: Results, discussion and analyses

The results from the investigations were presented in this chapter as well as detailed discussions and analyses. The author presented various figures and tables to illustrate the results, discussions and analyses of the results based on the findings. The author also used statistical analyses tools such as correlation coefficients, linear regressions and boxplots to analyse results.

Chapter 5: Synthesis, recommendations and conclusion

In this chapter the author synthesised the key findings and results and formulated applicable recommendations. The author also summarised and consolidated the study in this chapter and identified areas in the industry, water management systems and lodge operations which require further investigation.

1.7 Summary of chapter

The tourism industry is highly dependable on water and requires water for basic human consumption, irrigation of gardens and golf courses, preparation of food and drinks, making snow for winter sports and general water activities such as swimming or motorised water sports. Water management in wildlife lodges involve all the processes and procedures from the abstraction point to discharging back into the environment. This include the volume of water, quality of the water, purification and reticulation systems, water recycling, sewage treatment and finally discharging back into the environment. International standards are irrelevant for tourism ventures in Southern Africa due to the different configuration regarding staff. The aim of the study was to investigate the current water management systems lodges in the wildlife lodge industry in South Africa, Namibia and Botswana are currently implementing and to identify gaps in the current water management systems to improve their current systems. Other management components such as stakeholder involvement were identified as well as their level of involvement were investigated. Financial implications and monitoring of systems were also addressed in this study.

2. Literature study

2.1 Introduction

This chapter explains the importance of water management in the wildlife lodge industry. Water management has two main components, water quantity and water quality. The literature study is divided into three sections. The first section will explain the impacts poor water management can have with regards to water quality and quantity and the impacts it has on human health, ecosystems, local communities and business operations. The second section emphasises important components of a water management system with regards to water quality, quantity and other management components such as stakeholder involvement and financial implications. The final section identifies water challenges that might arise in the near future with regards to water quality, quantity and management.

Figure 2.1 illustrates that the author started off by identifying impacts poor management can have on human health, eco-systems, communities and business operations. This was important to gain a better understanding of what the consequences of poor water management entails, with special regard to human health, eco-systems, communities and business operations. The author then consulted literature on water quality management, water quantity management, stakeholder involvement, financial implications and monitoring measures. It was important to consult similar studies to provide a framework for the author to identify international trends, standards, methodologies and analyses techniques. The third section of the literature review was to identify possible future challenges. With these challenges in mind the author could make recommendations based on the current challenges as well as problems that might occur in the future. The consulted literature was also used to determine the design of the study and guided the author how to approach to study by pre-determining the end-points of the results.

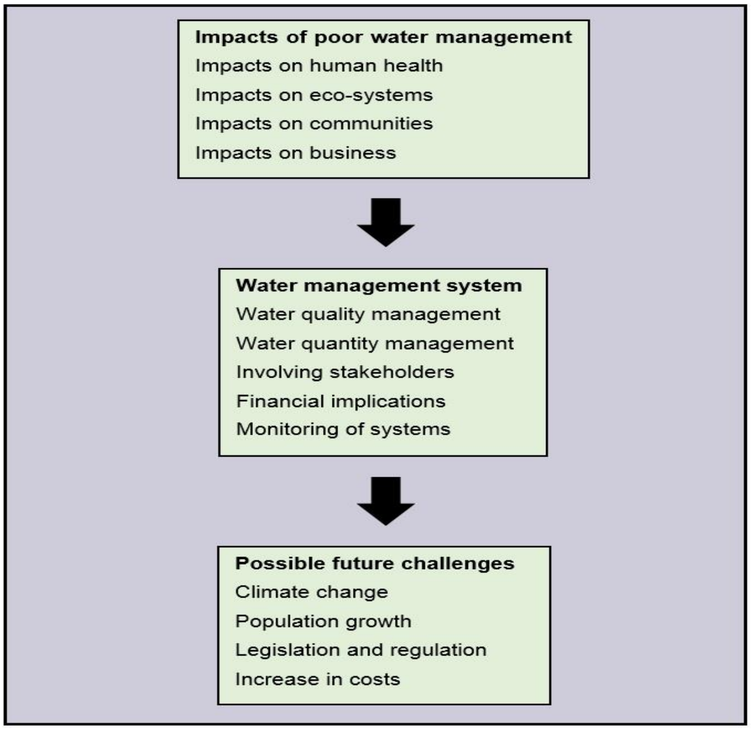

Figure 2.1: Flow diagram of literature study

2.2 Impacts of poor water management

2.2.1 Impacts on human health

Humans simply cannot live without water as we need water for basic consumption, hydration, food preparation and hygiene purposes (Howard & Bartram, 2003). Tourism activities contributes to water consumption and can be partially responsible for depleting water sources. This could lead to starvation in local communities, poor hygiene and health concerns as well as accelerating the spread of diseases, dehydration and ultimately death. Other health problems such as cancer, anaemia, sleeping disorders, poor appetite, constipation, vomiting, kidney problems and abdominal pain are diseases related to poor water quality (Khan *et al*., 2013). It is thus of utmost importance that tourism ventures apply sustainable water utilisation and preserve good quality freshwater as the well-being of staff and guests depend on the availability of good quality freshwater.

Since staff reside at most of the lodges in the wildlife lodge industry, good quality water is required to keep staff healthy (Mearns & Grobler, 2016). Poor quality drinking water can cause illnesses amongst staff and threaten lodge operations due to staff absences and shortages. Guests also consumes water at the lodges and to prevent legal law suites it is imperative that good quality water is available at the lodges.

2.2.2 Impacts on eco-systems

Depleting water courses can have a severe decrease on biodiversity on both aquatic and terrestrial eco-systems (Bond *et al*., 2008). It can also change animal behaviour forcing them to migrate to other regions since their survival is dependent on water. Since the wildlife lodge industry depend on wildlife and ecosystems for their existence, it is important that water courses and quantity is managed to prevent them from losing their tourist attractions. Muńoz and Fernandez-Alba (2007) stated that reverse osmosis can solve water shortages in dry regions and can significantly reduce negative environmental impacts by desalinising brackish groundwater. It will also put less stress on surface water and aquatic eco-systems.

The other main concern with tourism activities is their wastewater discharge. Wastewater with a high nutrient content can cause eutrophication (Gössling *et al*., 2015). This can result in algae blooms, including blue-green algae which is toxic to animals and can result in death. Wastewater with a high Chemical Oxygen Demand (COD) will reduce the dissolved oxygen in water courses, reducing precious oxygen available for aquatic animals to survive. A rapid decrease in oxygen levels in freshwater eco-systems could lead to a massive loss in biodiversity.

2.2.3 Impacts on local communities

In some areas tourism may compete for water directly with local communities for domestic use or local farmers for agricultural use. In Fiji and Sri Lanka tourism water usage is 8.5 times more per person per night than that of the local community (Becken, 2014). In Zanzibar, Tanzania, the average use per capita of freshwater for tourists is 15 higher than local residents (Gössling, 2001). Such imbalances could lead to water conflict situations and tourism ventures must integrate their needs with local communities to obtain the best outcomes for businesses, tourists, communities and the environment (Becken, 2014).

LaVanchy (2017) also conducted a study in Nicaragua and discovered that growing tourism and consumption was diminishing groundwater recharge which lead to conflict amongst the stakeholders. LaVanchy (2017) concluded that the struggles over water resulted in unsustainable tourism development due to abstraction exceeding aquifers' capacity.

Tourism activities can also impact negatively on the quality of water increasing health problems in local communities. In Lijiang Ancient Town, China, tourist numbers increased from 2 812 000 arrivals in 2000 up to 4 600 000 in 2006. An investigation on the residents' attitudes was carried out, aimed at visually and clearly understanding the condition of water quality deterioration in the area. The results showed that the water quality from the source dropped from a grade I, which could be consumed directly by humans and animals to a grade V, the worst grade possible. Too many tourists, inefficient management of the number of shops and their activities and the poor infrastructure construction of waste water collection and disposal has resulted in the decline of water quality (Baoying & Yuanqing, 2007).

2.2.4 Impacts on business operations

When water resources are depleted it can have massive financial impacts on businesses. In some cases it might even force managers to close certain lodges or sections of operations to accommodate tourists (J. Braack, Personal communication, 22 July, 2015). Mearns and Grobler (2016) evaluated the financial value of water at Phinda Private Nature Reserve in KwaZulu Natal, South Africa and the results showed that one litre of water generates an average income of R5.60 through tourism activities. Considering the volume of water the lodges consume, it does add to a substantial amount of money and lodges could lose Rands in the short space of a month should the lodges need to cease their operations as a result of water shortages.

Not only can good management and sustainable development benefit the environment, but it can also greatly contribute to an organisations corporate image and business growth as indicated by Molina-Azorín *et al*. (2015). Molina-Azorín *et al*. (2015) investigated the effects of quality and environmental management and its competitive advantages. The results indicated that hotels applying quality management practices improved their environmental performance by reducing environmental impacts.

2.3 Water management system

2.3.1 Water quality management

The tourism industry depend on good quality drinking water to meet tourist expectations and especially where staff live on the premises. Tourism can impact negatively on water quality if discharge is not managed properly. Wastewater and sewage discharge may contain nutrients and other pollutants such as chlorinated pool water or chemicals used to dissolve fats and oils during cleaning and in kitchens (Kuss *et al*., 1990). Water quality testing and analysis are usually done by external experts or laboratories since the equipment is rather expensive and the lack of scientific knowledge of staff. Grobler and Mearns (2017) stated that water quality results can be used as management tool if used properly. Grobler and Mearns (2017) further stated that water quality analysis should be done at the following locations for the following reasons:

- **The source**: It is important to know the quality of the source as this will determine the processes required to purify the water to drinking quality.
- **After treatment**: The water quality results will indicate whether the treatment was sufficient and if the water is fit for human consumption. Over time these results can indicate maintenance requirements such as changing of membranes, filters or other issues should water quality decrease.
- **Wastewater after treatment, before discharge**: This will indicate whether the wastewater and sewage treatment processes were successful and indicate the impact the discharge can have on eco-systems or water quality should it be discharged into a water course.

Water quality are mostly measured against standards or statutory regulations. In this study the author will use the individual country's statutory requirements and national standards to measure water quality against. For South Africa the author will use the South African National Standard (SANS) 241: 2015 Drinking water quality standard (SABS, 2015) to measure drinking water quality against. For wastewater, the author will use the limits as stated in the National Water Act no. 36 of 1998. For Botswana the author will use the Botswana Bureau of Standards BOS 93:2004 (Walmsley & Patel, 2011) for wastewater comparison and the BOS 32:2009 for drinking water comparisons. For Namibia the guidelines as stated in Article 140 of Act no. 1 of 1990 (Walmsley & Patel, 2011) will be used to measure drinking water as well as wastewater results against. The standards for all three countries are stated in Appendix A to F individually.

2.3.2 Water quantity management

Water consumption can be measured by concentrating on water throughput (Styles *et al*., 2015). This method focussed on the total volume consumed divided by the number of guest nights at a hotel or resort. This calculation would state the volume, usually in litre, per person per night or litre per guest night. These measurements are still the standard today however Gössling *et al*. (2015) stated that water consumption is much more sophisticated when considering all the water that is required to sustain the tourism system. Gössling *et al*. (2015) differentiated water into three major components: direct water use, indirect water use and systematic water use.

- **Direct water use** is water that is directly consumed by the hotel, resort or lodge. This will include all water that is consumed by rooms (toilets, taps and showers), irrigation (gardens, golf courses and lawns), laundry and cleaning, wash bays, kitchens (guest and staff), swimming pools (initial filling, filter backwash, evaporation) and staff quarters (Gössling *et al*. 2015).
- **Indirect water use** is water that is consumed to provide services to the establishments. This would include water used in the construction phase of the hotel, resort or lodge, energy production, fuel production and food and beverage production (Gössling *et al*. 2015).
- **Systematic water use** is all water consumed coupled with activities, shopping and services in transit to or in the destination. This will often entail other infrastructure such as railways, roads, airports and harbours, all of which encompass water use. Water use embodied in these properties has not yet been studied (Gössling *et al*. 2015).

In this study the author will only focus on the direct water use at the lodges in the wildlife industry and present the results as per the standard, litre per guest night. When direct water use is calculated, it is important that the measuring and data collection is done frequently and accurately. Water flow meters and equipment must be in proper working order and the data must be recorded as accurately as possible. Another important aspect is that the flow meters are installed at the correct locations in the system. When water is measured before water is stored and dispensed, it can impact on the data and can result in unreliable results. When other equipment such as flow switches or automated systems are faulty, it can lead to storage units overflowing again making the results inaccurate. It is therefore important to ensure that all meters and equipment are in good working order and that water meters are installed in the correct locations.

Developing baseline and benchmarks

A baseline assessment is the collecting and processing of data to establish a baseline result. The purpose of establishing baselines is to provide a starting point from which future measurements and predictions can be calculated. It can aid in forecasting water use based on the number of expected arrivals, and can aid managers in better water management (Gössling *et al*., 2015). Baseline assessments are not standardised and many different formats can be used in different situations. With regards to water quantity in the tourism sector, the baseline water consumption would be the volume that is consumed per guest per day or per room per day. The baseline can be exclusive to a specific destination, region, province, country, industry or market segment. Table 1 states baselines for specific countries and regions from previous studies (Gössling *et al*., 2015).

Table 2.1: Baseline water consumption for tourism ventures by country / region

Country	Accommodation type	Water use per guest per night
Mediterranean	Mostly hotels	250 L
Mediterranean	Campsites	145 L
Mediterranean	All accommodation	440 – 880 L
Benidorm, Spain	Campsites	84 L
Benidorm, Spain	1 Star hotel	174 L
Benidorm, Spain	2 Star hotel	194 L

Benidorm, Spain	3 Star hotel	287 L
Benidorm, Spain	4 Star hotel	361 L
Greece	5 Star hotel	675 L
Greece	4 Star hotel	234 L
Tunisia	Hotels	466 L
Morocco	Apartments	180 L
Morocco	3 Star or villa	300 L
Morocco	4 Star hotel	400 L
Morocco	5 Star hotel	500 L
Morocco	Luxury 5 Star hotel	600 L
Sarigerme, Turkey	4 Star hotel	400 – 1000+ L
Sharm El Sheikh, Egypt	Hotels	< 500 L (per bed)
Sharm El Sheikh, Egypt	5 Star hotels	1410 – 2190 L (per room)
Zanzibar, Tanzania	Guesthouses	248 L
Zanzibar, Tanzania	Hotels	931 L
Zanzibar, Tanzania	Hotels and guesthouse (average)	685 L
Jamaica	Unspecified	527 – 1596 L
Jamaica	Average	980 L
Thailand		913 – 3423 L (per room)
Philippines	4 Star hotel	1802 L (per room)
Hong Kong	Hotels	336 – 3198 L (per room)
Australia	Hotels	750 L (per room)
Australia	Large hotels	300 L (per room)
Melbourne, Australia	Various	227 – 435 L
USA	Unspecified	382 – 787 L (per room)
Las Vegas, USA	Hotels / resorts	303 L
Seattle, USA	Hotels	378 – 1514 L (per room)
Germany	Unspecified	90 – 900 L
Germany	Average	340 L
Scandinavia	Hilton chain	516 L
Scandinavia	Scandic chain	216 L
Coastal Normandy, France	Campsite	92 L
Coastal Normandy, France	Hotel restaurant	259 L
Coastal Normandy, France	Hotel	175 L
Coastal Normandy, France	Other	115 L

(Gössling *et al*., 2015)

Baselines can be used as benchmarks when they are compared against each other, however this will be explained in more detail later.

Benchmarking is a comparative management tool that is widely used all over the world. The aim of benchmarking is for continuous improvement in performance and best practice of an organisation. The process involves measuring one's own performance and evaluate it against the best in class or similar organisations (Saagi, Kroll, Flores-Alsina & Jeppson, 2017). The four main types of benchmarking is:

- Internal benchmarking

  Internal benchmarking is a comparison of a business process to a similar process inside the organization for example a company such as Wilderness Safaris comparing water use of one of their lodges to another. This method is fairly cost efficient and access to information is easily obtainable. It can however be influenced by internal bias and may not yield the best in class comparison (Córcoles *et al*., 2010).
- Competitive benchmarking

  Competitive benchmarking is the comparison of a product, service, process, or method against direct competitor for example Wilderness Safaris comparing their performance against &Beyond. Competitors may have similar regulatory issues and competitive benchmarking could lead to possible partnerships. Some disadvantages of this method is that competitors might provide misleading information, exploit your weaknesses and it could lead to minimum performance improvement (Córcoles *et al*., 2010).
- Functional benchmarking

  Functional benchmarking is a comparison to similar or identical practices within the same or similar functions outside the immediate industry for example &Beyond comparing their wastewater works with industrial wastewater works. Although this can result in a better improvement rate, it is more time consuming and involves adaptation of best practices (Córcoles *et al*., 2010).
- Generic benchmarking

Generic benchmarking broadly conceptualizes unrelated business processes or functions that can be practiced in the same or similar ways regardless of the industry. Some advantages of this method is that it is non-competitive, innovative and examines multiple industries, however it can be difficult to identify the best in class and can be very time consuming (Córcoles *et al*., 2010).

2.3.3 Involve all stakeholders

Water management requires the involvement of all stakeholders such as local, regional and national governments, local communities, staff and guests. These stakeholders are explained in detail below.

Local, regional and national governments

In most countries in the Southern African Developing Community (SADC), citizens have the right to an environment that is does not cause harm to its people and considers the wellbeing of its citizens through the protection of the environment included in their country's Constitution, with the exception of Botswana, Zambia and Zimbabwe (Walmsley & Patel, 2011). Although these rights are provided through a diversity of policies and standards in these three countries, it does not rectify the constitutional position, as a standard or policy is not a legal document. Governments are thus constitutionally liable to promote sustainable social and economic development, protection of the environment and the provision of sustainable services such as water (Haigh, Fox, Davies-Coleman & Hughes, 2008). Governments often provide frameworks, standards and other means such as by-laws to protect natural resources. Government involvement is therefore a crucial component to any water management system.

Local communities

Local communities are often competitors for water and many communities' livelihood depend on natural water resources. Water resources cannot be seen in isolation of the surrounding ecosystems and the people (Heyd & Neef, 2004). Involving local communities can limit the possibilities of unrest and conflict. It is important to have input and agreements with local communities in place for any water management system.

Staff

It is important for staff to be familiar with the underlying motives for water management to encourage staff to improve environmental performance. Staff can greatly reduce water consumption and can save money by using water more sustainably (Gössling *et al*., 2015). Staff training are crucial to sustainable water management as they also live on the premises, can monitor leakages and other problems and can also increase water consumption when cleaning rooms.

Guests

Different attitudes and sentiments exist whether to involve guests in environmental initiatives or not. Evidence show that a large majority of guests are receptive to a modest degree of involvement (Gössling *et al*., 2015). The most important aspect of involving guests is the means of communication that organisations use to inform their goals and objectives to its guests. An example of a proactive engagement initiative was done by Kuoni group in 2013 (Gössling *et al*., 2015). The initiative encouraged guests to re-use towels, keep taps closed when brushing teeth and only have linen changed every third day. The money saved on water was calculated at the end of each stay and the money was donated to similar projects.

2.3.4 Financial implications

It is unlikely that management will engage in management measures if it does not result in cost savings. After technologies and initiatives have been identified, managers must thus perform a cost-benefit analysis to determine whether the investment will be beneficial. The cost is calculated and compared to savings, considering payback timeframes and discount rates. Energy consumption is often considered when analysing new technologies and initiatives and plays a major role in the decision making. Decisions are then made to either proceed with the investment or consider other alternatives (Gössling *et al*., 2015).

2.3.5 Monitoring of systems

The purpose of monitoring a water management system is to identify gaps in the system and strive for continuous improvement. The most common form of monitoring a management system is by conducting audits (Gössling *et al*., 2015). Audits are carried out against a pre-determined set of criteria which will indicate whether the management system complies with company, legal or other statutory requirements. Audit results will indicate if the desired objectives have been met or not and will indicate areas which require attention and improvement (Gössling *et al*., 2015). Since staff play an important role in a water management system, their contributions and efforts must be included in any monitoring approach and they must be held accountable for their responsibilities (Mearns & Grobler, 2016).

Another approach to monitor a water management system is through investigations of audit findings. A common approach here is the Root Cause Analysis Technique (RCAT). This approach focus on the end point or impact of a finding and work is way backwards to determine where the system failure occurred. The RCAT approach will indicate whether findings were due to equipment failure, incorrect procedures, lack of management or any other possible reasons.

2.4 Possible future challenges

2.4.1 Climate change

Climate change will impact future water resources in various ways. Changes in the water cycle have already been observed by scientists such as higher humidity levels in the atmosphere, changing regional rainfall patterns, more frequent flash floods and a decline in seasonal snow and glacial ice (Intergovernmental Panel on Climate Change (IPCC), 2007) These factors are some of the most direct ways that countries and communities will experience the effect of climate change (IPCC, 2007).

Rainfall and evaporation are the principle climatic drivers controlling freshwater resources and will impact the reliability of annual and seasonal freshwater supply. Predictions show that generally wet regions will become wetter whereas drier regions will suffer severe droughts (Schlosser, Strzepel, Xiang, Fant, Blanc, Paltsev, Jcoby, Reily and Gueneau, 2014) Increased temperatures will also result in greater evaporation in rivers, lakes and reservoirs, reducing the availability of freshwater supply.

Another way climate change will impact on water is the quality. The more frequent flash floods will amplify water runoff and will increase nutrient and pollutant presence in the water quality, threatening the safe consumption of drinking water even with standard treatment (Schlosser *et al*., 2014). The increase in water temperatures will also increase the risk of algal blooms and other pathogens which will require greater treatment than the current conventional ways. Less flow associated with increase droughts will reduce the dilution of pollutants and can severely degrade the water quality and increase the likelihood of waterborne diseases (Gössling *et al*., 2015).

Coastal areas and islands face an additional threat to their freshwater supply. Coastal freshwater aquifers and wetlands run the risk of salt intrusion as studies are projecting the global sea level to rise as much as one meter (Gössling *et al*., 2015). This will substantially reduce freshwater resources in these destinations (Rahmstorf, 2010). Greater temperatures and increased periods of drought will increase the demand for freshwater by a variety of users, including irrigation, industrial and energy-related cooling as well as ecosystems. The combined effects of climate change will drastically increase the cost of water and could impact on poor communities with fatal results (Rahmstorf, 2010).

2.4.2 Population growth

Population growth will play a major role in the demand of freshwater. Food security and drinking water will assert major stress on water sources. Nearly 80% of global water consumption is consumed by the agriculture industry. With growing populations this number will have to increase as well to provide food security. Hoekstra (2014) also mentioned that increased energy demands associated with population growth will severely increase the demand for freshwater and will increase competition amongst users. Regions already with limited water supply will have the fiercest competition amongst water users across all sectors.

2.4.3 Legislation and regulation

With the impacts of climate change, population growth and water quality and quantity degradation, governments and regulators will play a major role in the future of water management (Gössling *et al*., 2015). This could involve strategies such as water limits and restrictions per person or household per day or month, seeking alternatives such as rainwater harvesting, limiting the size of gardens and swimming pools, stricter regulation with regards to water quality (reduce limits and increase frequency of testing) as well as water recycling on an industrial scale. Governments will be forced to implement fines and imprisonments for series or regular offenders (Gössling *et al*., 2015).

2.4.4 Increase in cost

The biggest concern in water poor areas is that the cost of water will increase. Growing populations will demand expanding infrastructure and with weather patterns changing, alternative resources will have to be researched (Anisfield, 2010). Legislation changes can also force municipalities and industrial complexes to implement water recycling systems which will increase energy consumption as well as cost to businesses. Increasing stress on water sources may see governments charge a water tax or water levy to cover the high cost involved with water security. An increase in water cost will also mean an increase in all products requiring water during its manufacturing processes. This could lead to increased inflation rates and reduce economic growth (Anisfield, 2010).

2.5 Summary of chapter

Poor water management can have negative impacts on human health, eco-systems, local communities and business operations. Baseline assessments and benchmarks can assist organizations in improving their water management systems. The available literature about water in the tourism industry focus mainly on hotels in cities and coastal resorts along the Mediterranean Sea. Very little research has been done in Africa and especially in the wildlife lodge industry. Stakeholders that should be included in a water management system include local, regional and national governments, local communities, staff and guests. Depleting water resources can financially have huge impacts on the operations and sustainability of lodges. Future challenges such as climate change, population growth and an increase in water costs poses a high threat to the existence and growth of wildlife lodges.

3. Organisations, study area, design and methodology

3.1 Introduction

In this chapter the author provided the details of the organizations that participated in this study. The study area is also clearly illustrated and explained to highlight the different environments in which the lodges operate. The design of the study is also explained as well as the methodology that was implemented to obtain the results.

3.2. Organisations

Two of the major organisations in the wildlife lodge industry in South Africa were approached for this study, &Beyond and Wilderness Safaris. Both organisations had lodges in the three selected countries in this study. An overview of the companies are stated below.

&Beyond

&Beyond was established in 1991 (then called Conservation Corporation Africa or CC Africa) due to rising international demand for ecotourism and wildlife experiences. The organisation is a progression of the model originally established over 30 years ago at Londolozi Private Game Reserve. This model demonstrated that, by harnessing international capital through low-impact, high-yield tourism, conservation land could prove its economic viability whilst affording rural communities a meaningful share of the benefits. The spirit and effectiveness of this model, lead to company's core ethic of "Care of the Land, Care of the Wildlife, Care of the People" (&Beyond, 2017).

&Beyond began in the early 1990s at Phinda Private Nature Reserve in KwaZulu-Natal, South Africa. With its vast involvement in the local community, &Beyond established the Rural Investment Fund, now known as the Africa Foundation. The Africa Foundation focuses on rural development around &Beyond lodges and reserves, and facilitates international financial support for responsible, consultative community projects in rural Africa (&Beyond, 2017).

From 1995 &Beyond continued to expand its portfolio of superior safari lodges and moved into Kenya, Zimbabwe and Tanzania, and later Botswana and Namibia. In February 2000, &Beyond merged with two other travel outfits (Afro Ventures and Into Africa) to form one of Africa's most comprehensive tourism companies, combining the strength of its lodge portfolio with a large tour operating division, destination management, group travel and mobile safari specialist operation. &Beyond now offers personalised, luxury tours in 12 African countries (&Beyond, 2017). In 2006 &Beyond extended into India, Sri Lanka, Bhutan and Nepal. This expansion resulted in the name change in 2008 from CC Africa to &Beyond to reflect the company's extended footprint beyond Africa. South America was added to the portfolio in 2015, adding Chile, Argentina, Peru and Ecuador to &Beyond's experiential travel offering (&Beyond, 2017). Figure 3.1 indicate the location of all &Beyond's lodges in the three selected countries for this study. Due to the author's anonymity agreement with the organisations, no lodge names will be stated in this study, even on the maps.

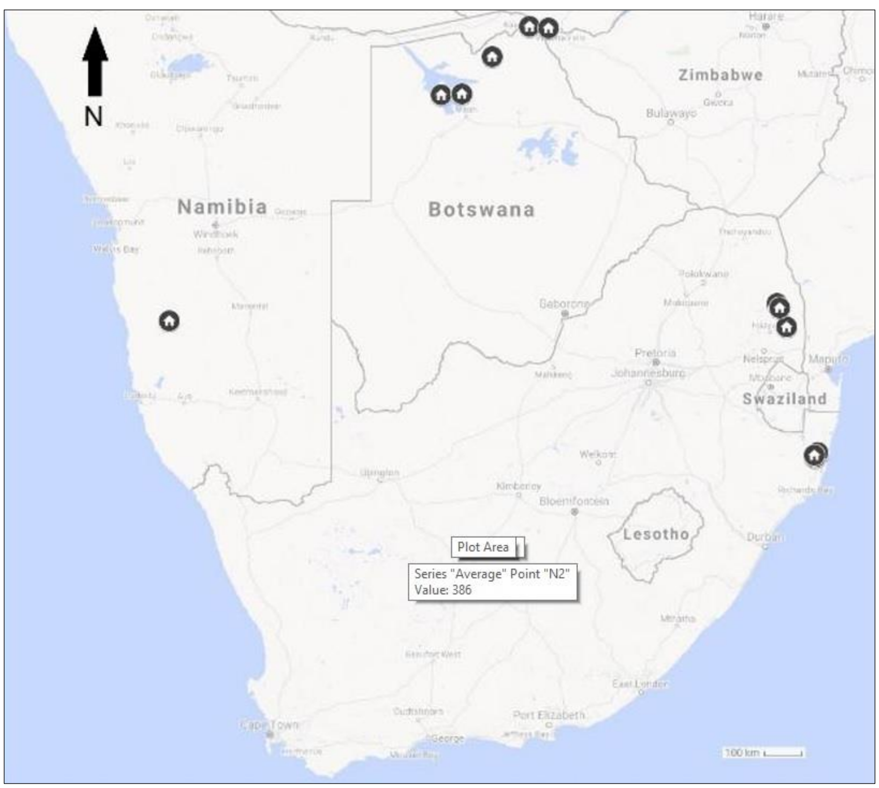

Figure 3.1: &Beyond lodges in South Africa, Namibia and Botswana (Google maps, 2017)

Wilderness Safaris

Wilderness Safaris was founded in Botswana in 1983. It started off as mobile tented safari that hosted tourists in and around the Okavango Delta. Today Wilderness Safaris offer private access to 2.5 million hectares of Africa's finest wildlife and wilderness areas. The company owns and manages 40 luxury camps in Africa and offer safaris across eight African countries: Botswana, Kenya, Namibia, Rwanda, Seychelles, South Africa, Zambia and Zimbabwe (Wilderness Safaris, 2016).

Similar to &Beyond, Wilderness Safaris designed their vision based on what the company call the 4C's: Commerce, Conservation, Community and Culture. Commerce deals with the ecotourism offerings and products and is regarded by the organisation as the most critical element to sustainability in the modern world. It also focus on creating life-changing experiences for clients and guests, while working closely with local governments, community shareholder and stakeholder to ensure a sustainable business.

The conservation vision aims to maximise positive impacts of their operations on biodiversity and to minimise negative impacts. This is divided into two sections. Environmental Management Systems (EMS) deal with how the organisation build and manage their camps in the most eco-friendly way possible. The biodiversity conservation element covers the understanding, management and protection of wildlife and ecosystems.

The Community vision includes staff, partners in the travel industry, guests and communities in or adjacent to operation areas. The organisation believes in honest, mutually beneficial and dignified relationships with their community partners. Culture aims to promote the unique Wilderness culture across the globe to respect and care for the environment. Other initiatives include the Wilderness Wildlife trust and the Children in Wilderness programme (Wilderness Safaris, 2016).

Apart from their primary aim of sharing Africa's wonderful places with guests, the organisation states that their ultimate goal is to make a difference in Africa, its people and its wildlife (Wilderness Safaris, 2016).

Figure 3.2 below illustrates the location of all Wilderness Safaris lodges in South Africa, Namibia and Botswana. Figure 8, 9 and 10 illustrate the location of Wilderness Safaris lodges in South Africa, Namibia and Botswana as per country.

Figure 3.2: Wilderness Safaris lodges in South Africa, Namibia and Botswana (Google maps, 2017)

3.3 Study area

Lodges in South Africa, Namibia and Botswana from &Beyond and Wilderness Safaris were selected based on the availability of data. The regions from the selected lodges differs vastly from desert, swampland, coastal forest and savanna (see figure 3.3). The geographical locations of the lodges could possibly impact the quality of the water as well water consumption as water in certain regions are a scarce resource and abundant in others. More information about the regions are explained below at the relevant sections.

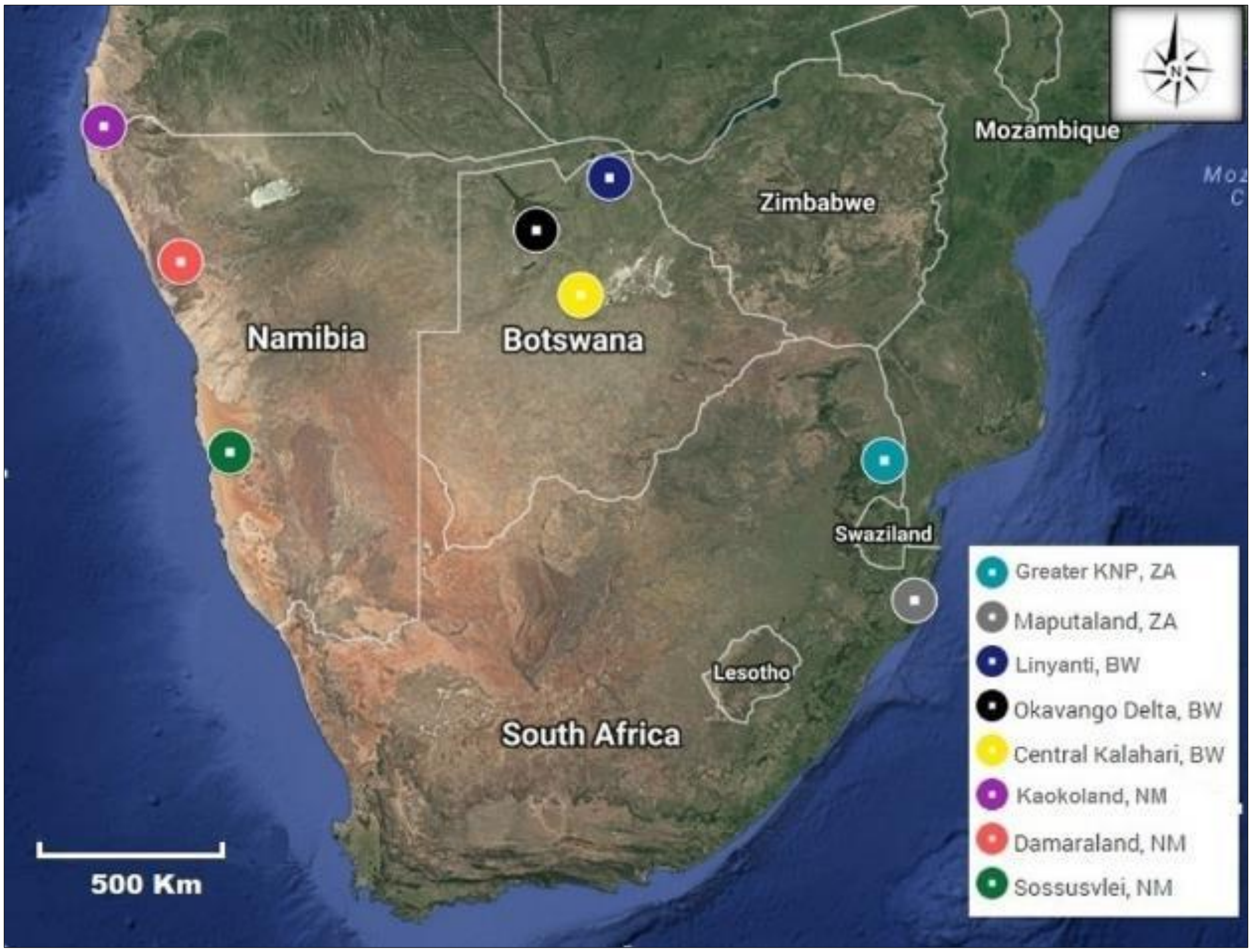

Figure 3.3: Map of the selected regions across South Africa, Namibia and Botswana (Google maps, 2016)

3.3.1 South Africa

- Maputaland

Maputaland is situated in the north-eastern parts of KwaZulu Natal in South Africa (&Beyond, 2017). The region receives approximately 590mm of rain per annum with most of the rainfall occurring during the summer months (October to April). Temperature ranges between 8°C to 23°C during the winter months (May to September) and between 24°C to 34°C during summer (Bushcapes, 2015). The region has several distinct ecosystems such as palm savannah, mountain bush, rare sand and coastal forest and dense thornveld (Bushscapes, 2015). The region has several big 5 nature reserves and the Isimangaliso Wetland Park is one of South Africa's World Heritage Sites. The Maputaland Marine Reserve provides a sanctuary for prolific marine life and vibrant coral reefs.

The area is underlain by late Mesozoic and Quaternary sequences (Watkeys *et al*., 1993). The area is rich in biodiversity due to its sub-tropical transition zone and variations in climate and geology.

- Greater Kruger National Park

  The Greater Kruger National Park (GKNP) is located in the Limpopo and Mpumalanga provinces of South Africa. Approximately 20 private nature reserves bordering the Kruger National Park on the west dropped their fences, adding an additional 180 000 hectares to the Kruger National Park (Timbavati Private Nature Reserve, 2017). All lodges in GKNP are privately owned. The GKNP is situated within the Savanna biome which covers about 32% of South Africa. Savanna is classified as a vegetation type consisting of both a tree and grass layer with complex interactions between these two structural layers.

  Annual rainfall range between 200 mm to 1500 mm per annum, with the wet season occurring between the months of November to March. Summers are hot to uncomfortably hot with a long term mean maximum temperature of 38 °C in the months of January to April (Timbavati Private Nature Reserve, 2017).

  Granite and gneiss are the dominant geological formations of the GNKP. These rock types are rich in feldspar and quartzite which consists of silica and oxygen with very little iron (ferro) and magnesium (ferro-magnesium) minerals in them. Due to these rock formations sandy soils characterise the landscape of the GKNP, in turn determining the species composition and with the rainfall the structure of the vegetation (Timbavati Private Nature Reserve, 2017).

3.3.2 Namibia

- Sossusvlei

  Sossusvlei is situated in the largest conservation area in Africa, the Namib-Naukluft National Park (Wilderness Safaris, 2016). The area consists of 4,9 million hectares and encompass a large portion of the Namib Desert. The area is characterised by its enormous sand dunes, some reaching almost 400 meters and measure amongst the highest dunes in the world. The area consist mainly of sand, however metamorphic mountains composed of mainly limestone and shale are present on the eastern boundary. The mountains in Naukluft formed approximately 850 million years ago during the formation of Gondwana. Land masses converging produced mountain belts from shallow water marine deposits (Bridgeford *et al*., 1997). The area receives a paltry 50 – 100mm of rain per annum. Despite the lack of vegetation and low rainfall, the area is not without life and a surprisingly diverse array of insects, rodents and reptiles can be found (Wilderness Safaris, 2016).

- Damaraland

  Damaraland is situated in the north-western parts of Namibia. It is one of the most scenic areas in Namibia with deep gorges from prehistoric water courses, open plains and grassland and enormous granite koppies. Damaraland is home to a variety of desert-adapted wildlife such as elephant, rhino, zebra and lion (Wilderness Safaris, 2016).

  Damaraland has a harsh semi-desert climate with wide variations in temperature due to changing altitudes. During summer (November to April), daytime temperatures average around 30°C but can rise to well above 38°C. Winter (May to August) temperatures range between 25°C and 10°C but can drop below zero on some nights. The rain season occurs during the summer and consists of sporadic rainfall. In the winter season, conditions are extremely dry and any precipitation is incredibly rare (Wilderness Safaris, 2016).

- Kaokoveld

  The Kaokoveld is situated in the far north-west corner of Namibia south of the Kunene River, bordering Angola. The area is a vast desert and experience extreme weather conditions and variations due to altitude changes. In summer (October to April) temperatures average around 26°C but can rise well above 38°C. In winter (May to August) freezing temperatures can be experienced during night time. The areas has several granite mountain ranges such as the Baynes Mountains, Hartmann Mountains and Otjihipa Mountains (Vogelsang, 2000). Rainfall in the region is below 100mm per annum and winters can be extremely dry. Occasional thunderstorms occur in summer but precipitation are scarce and rare (Vogelsang, 2000).

3.3.3 Botswana

- Central Kalahari

  The Central Kalahari Game Reserve is situated in the Kalahari Desert, a semi-arid sandy savannah in the central parts of Botswana. The reserve is the largest conservation area in Botswana and one of the largest in the world. The area is famous for its black-maned lion as well as some of the world's best cheetah viewing.

  During summer (November to April), daytime temperatures average around 30°C but can rise to as much as 40°C. Winter (May to August) day temperatures average around 25°C. Because there is no cloud cover during winter, the nights are very cold, sometimes getting as low as -10°C (Wilderness Safaris, 2016).

  Annual precipitation is less than 100mm per annum and occurs during the summer months. Rainfall tends to be inconsistent, unpredictable and highly regional. Most if it falls during heavy thunderstorms, often accompanied by strong winds and dust storms (Wilderness Safaris, 2016).

- Okavango Delta

  The Okavango Delta is situated in the northern parts of Botswana and is one of the largest inland delta systems in the world, consisting of an area of 16 000 Km^2. The area is filled with water channels, lagoons and islands and what makes this area truly remarkable is that it is situated deep in the Kalahari Desert (Wilderness Safaris, 2016). The delta is fed by the Okavango River which originates in Angola. The area is a UNESCO World Heritage site and is a popular destination due to its abundance of wildlife.

  The area receives an average annual rainfall of 450mm per annum, mainly during the summer months of December to March (Wilderness Safaris, 2017). Daytime temperatures during these months can reach up to 40°C. Winter temperatures are mild to warm ranging between 10°C to 24°C.

- Linyanti region

  The Linyanti region is situated in the far north of Botswana, west of Chobe National Park and north-east of the Okavango Delta. The area consist of riverine woodlands along the Linyanti Fault line and the dryer woodlands inland from the waterways. The region host large concentrations of elephant, lion, sable, roan, hippos, and wild dog (Wilderness Safaris, 2017).

  The climate and rainfall patterns are very similar to the climate in the Okavango Delta, with an average rainfall of about 500mm per annum. Temperatures fall in the same range as those specified for the Okavango Delta, as well the rain and dry season.

The geographical location of the lodges could play a major part in this study. Lodges in water scarce regions might manage their water more intensely than lodges in areas where water is abundant. Since the lodge make use of local employment, staff perception and behaviour with regards to water could also play an important role in the volume of water that is consumed. Since geological features play a major role in water quality, it is important to identify the difference in water quality from the different regions as water purifying process might need to differ to obtain a healthy standard of water for human consumption purposes.

3.4. Research design and methodology

3.4.1 Research design

This multiple case study investigated water quantity and quality at each of the selected lodges. Secondary quantitative data was analysed and interpreted to achieve the aim and objectives of the study. The exploratory study was of an empirical design. The design was quantitative and consisted of statistical analysis and semi-structured interviews (qualitative). The purpose of selecting this design was because the study involved the collecting, measuring and analysis of a large number of existing data and records. The strengths of this design was that it is a form of applied research aimed at assessing whether interventions were conceptualised and properly implemented. Some limitations of the design was access and coverage to the sites and timing of the study. The mode of observation was water quantity measurements, water quality reports and key informant interviews with regional environmental managers and representatives. The interviews were semi-structured. The semi-structured questions that were used is stated in Appendix A. Techniques included tabulations and statistical graphics (bar charts, pie charts). The design was also subjective to errors such as measurement errors, subject effects and researcher effects (Mouton, 2001).

3.4.2. Methodology

All data that was obtained was for the 24 month period from March 2015 to February 2017. All the lodge names have been changed to codes to ensure anonymity as per agreement with the research partners. The first letter in the code refers to the country in which the lodge is situated, whereas the number at the end was the number that the author allocated to a specific lodge for identification, for example B3 will mean the third of the lodges whose data was analysed by the author in Botswana. Information obtained from staff members at the camps will not be referenced and names will not be published. Any statements from staff members will only be referred to as: “a staff member”. The reason for this approach is to protect the identity of any staff members. Bottled water was excluded from this study.

3.4.2.1 Water quality testing

The author obtained secondary data in the form of water quality analysis done at the lodges. The first part in this section focussed on how many lodges did water quality analysis on its source, tap and wastewater discharge. The second part in this section focussed on the frequency of testing. The author obtained annual / monthly water quality results or reports from the companies' representatives. Table 3.1 below stated how many lodges in their respective countries had water quality results of the source, tap and / or waste water discharge as well as how many lodges have not done any water quality testing.

Table 3.1: Water quality results at the lodges

Country	Source	Tap	Wastewater discharge	No tests
South Africa	4/8	7/8	6/8	1/8
Namibia	0/8	7/8	0/8	1/8
Botswana	5/15	5/15	0/15	10/15
All countries combined	9/31	19/31	6/31	12/31

From the seven lodges that had water quality results, five were tested annually whereas two lodges had done monthly testing.

3.4.2.2 Water quantity measurements

In this section the author used secondary data that was obtained from the two research partners during the specified period. The author identified how many lodges had complete sets of data (for all 24 months), how many lodges missed 1-2 months data and how many lodges missed 3 or months of data. This provided information on the effectiveness of their measuring system and identified if and where improvement was needed. The second part in this section dealt with where the water meters were installed and if measurements were accurate and reliable. An interview was conducted with the group sustainability manager from &Beyond and the environmental manager from Wilderness Safaris. The author also visited 12 camps to verify the information that was provided by the company representatives.

- Frequency and consistency of water records

Both organisations stated in their management systems that water data should be recorded and reported monthly. From the collected data, the author noticed gaps in the data. Table 3.2 summarises the compliance of the records with the organisations' own management systems and differentiate the data into three categories, lodges with complete sets of data for the full study period (March 2015 – February 2017), lodges with one to two months of missing data and lodges with more than three months of missing data.

Table 3.2: Frequency and consistency of water records

Country	Lodges with complete sets of data (all 24 months)	Lodges with 1-2 months of data missing	Lodges with 3 or more months of data missing
South Africa	2/8	2/8	4/8
Namibia	7/8	0/8	1/8
Botswana	11/15	1/15	3/15
All countries combined	20/31	3/31	8/31

- Accuracy of data

The author visited two lodges in Botswana and 10 lodges in South Africa to verify secondary data and information obtained during interviews. During the visits and interviews, the author identified two factors that have an effect on the accuracy of the data.

i) Location of water meters

At two of the lodges the author noticed that the water meter is installed before the water is stored in storage units. This will result in water being accounted for in the readings and being calculated into the consumption whilst the water is still in storage. The size of the storage units will determine the magnitude of influence it has on the accuracy. Figure 3.4 indicates the water system at the lodge where the meter was installed at the wrong location, whereas figure 3.5 illustrates the correct location for the water meter to be installed.

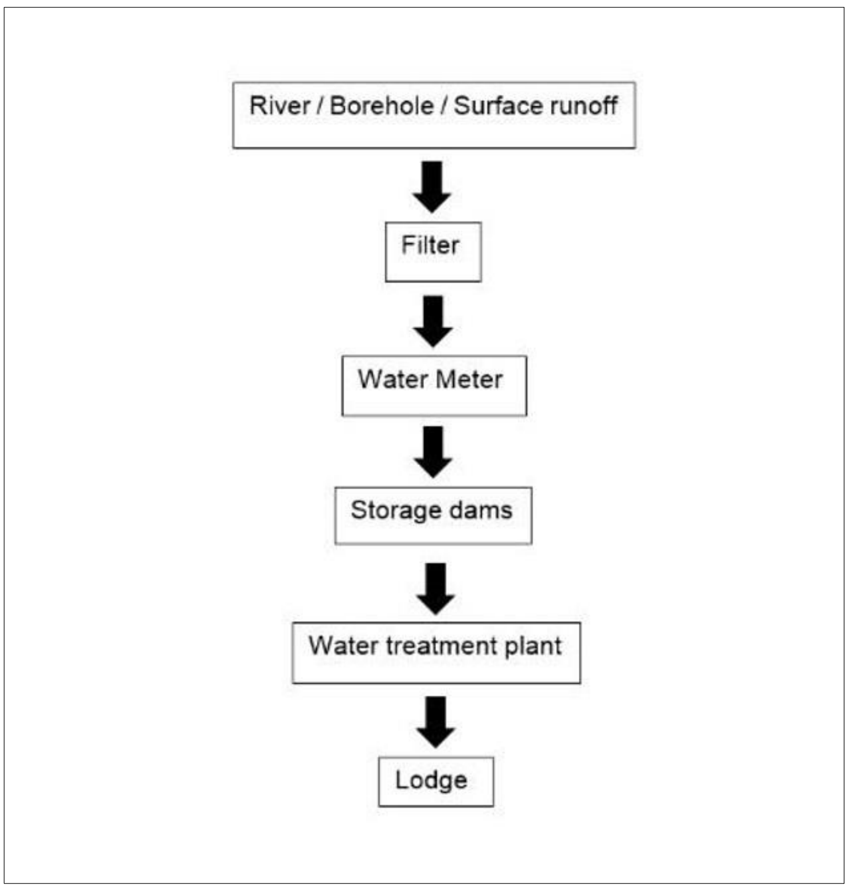

Figure 3.4: Incorrect location of water meter

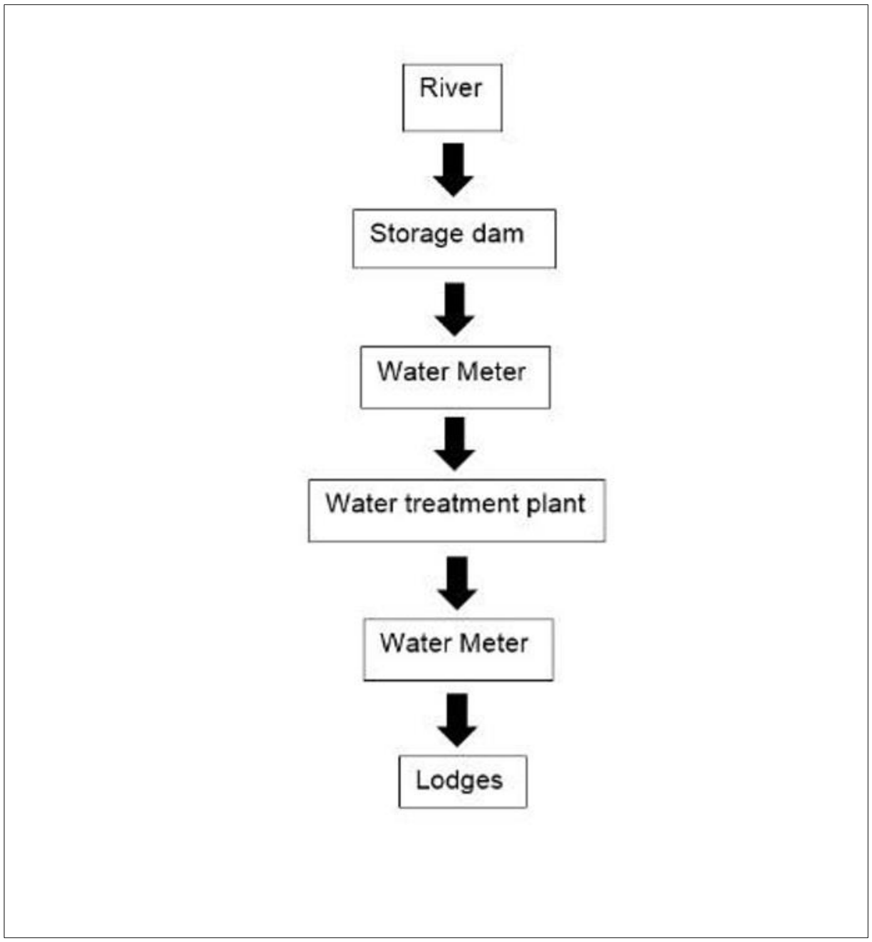

Figure 3.5: Correct location for waters meter resulting in more accurate data

ii) Faulty equipment

During an interview with a staff member, it was brought to the attention of the author that water meters tend to cease up in certain areas due to poor water quality. This could be due to corrosion, salt build up or scaling due to high calcium, magnesium or iron levels which accelerates corrosion. Due to the scaling and salt build, the months/weeks before the water meter ceased, the meter readings could be inaccurate due to a faulty water meter. Another piece of equipment that caused inaccurate readings at one of the lodges was a faulty automated float switch. Water was being pumped to storage units without the pump switching off automatically when the storage units are full. This resulted in an overflow at the storage units, again accounting water being consumed at the meter that were not utilised by staff or the lodge. The magnitude of influence on the accuracy would depend on how long the pump were running after the storage units were full. According to a staff member at the specific lodge, this tends to happen more often when there are less guests in the lodge rather than when occupancy is high due to staff being more relaxed and are under less pressure to perform.

3.4.2.3 Water quality results and compliance

The water quality results were graphed and measured against the relevant countries' standards to determine if the quality complies with standard limits. The relevant standards that were used are available in Appendix B to G. There were no guideline available for source quality and only tap and waste water guidelines were used.

3.4.2.4 Water quantity baselines and benchmarks

Since no baseline or benchmarks exist, the author used the secondary data to calculate the baseline water consumption from all three countries. The average water consumption from all three countries, both in l/g/n and l/b/n, were used to create a general baseline for the wildlife lodge industry in South Africa, Namibia and Botswana. The author then calculated the averages for each country individually and used the country's average, both in l/g/n and l/b/n as the baseline for the specific country. The author used the best-in-class method to provide a benchmark for each country as well as all three countries together. The lodge that had the least water consumption per capita, considering both l/g/n and l/b/n was used as the best-in-class benchmark for the specified country. The baselines and benchmarks were stated as per the international standard of litre per guest per night (l/g/n) as well as the inclusion of staff of litre per bed per night (l/b/n).

The author also used statistical analyses tools such as correlation coefficients, linear regressions and boxplots to analyse the results. The purpose of these analyses were to determine the role that seasons, level of service and staff contributions have on water consumption at the lodges. The author only differentiated between summer and winter to determine the impact seasons have on water consumption. Three factors determining the level of service were considered. These were the guest to staff ratio, rate in US $ and the number of pools at each lodge. Correlation coefficients were used to establish the correlation between water consumption per capita and the relevant factor. Where strong correlations were established the author used linear regressions to form a formula that would forecast water consumption based on the factors with strong correlations.

3.4.2.5 Other management components

a) Involving of stakeholders

Information regarding the involvement of all the stakeholders was obtained through interviews with the company representatives. A semi-structured questionnaire was used to obtain information with regards to the involvement of local, regional and national government, local communities, staff and guests. The information was used to establish two components. The first was to determine if these are stakeholders involved in water management systems and the second component was to determine to which extent they are involved. A copy of the questionnaire is attached as Appendix A.

b) Financial implications

The author obtained data from the company representatives during a semi-structured interview, using a questionnaire. Based on conservation measures and processes, the author determined the financial implications of water management systems. The results were presented based on the information provided by the company representatives. A copy of the questionnaire is attached as Appendix A.

c) Monitoring of systems

Information regarding monitoring of water management systems was obtained through interviews with the company representatives. A semi-structured questionnaire was used to obtain information with regards monitoring. The information obtained was used to determine the method of monitoring (audits, inspections, and / or management reports) and the frequency of monitoring. The author also investigated which criteria the organisations used to monitor their system. The results were presented based on the information that was obtained. A copy of the questionnaire is attached as Appendix A.

3.5. Ethics

The author committed in writing to conduct the study in accordance with the ethical procedures as required by the University of South Africa (UNISA). The author applied for ethical clearance from UNISA and ethical clearance and approval was granted to the author on 25 November 2016 by UNISA (see appendix H). As part of the ethical requirements the author had to obtain permission and consent from the research partners, &Beyond and Wilderness Safaris. Consent was granted by &Beyond based on an existing memorandum of agreement between UNISA and &Beyond (see appendix I). Wilderness Safaris also provided written consent and also specified their specific requirements in the consent letter (see appendix J). All the conditions from both research partners were adhered to at all times by the author. All the identities of the interviewees were protected. As per agreement with the research partners, no lodge names were mentioned to ensure their anonymity. The research were completed ethically, professionally and unbiased.

3.6 Summary of chapter

The author partnered with two of the leading wildlife lodge industry operators in Southern Africa, &Beyond and Wilderness Safaris for this study. Across South Africa, Namibia and Botswana, 31 lodges were selected to participate in this study. The locations and geography from the lodges differed vastly from desert to permanent swampland. The multiple case study was of empirical design and consisted from qualitative, statistical analysis and semi structured interviews. The data that was obtained was for the 24 month period from March 2015 to February 2017. The author used several methods to achieve the aim and objectives of the study and also used statistical analyses to process the results. The study was done in accordance with the ethical requirements of UNISA and all the agreements and requirements specified by the research partners were adhered to at all times.

4. Results, discussion and analyses

4.1 Introduction

In this chapter the author present the results from the investigations as well as detailed discussions and analyses of the results. The author presented various figures and tables to illustrate the results, discussions and analyses of the results based on the findings. The author also used statistical analyses tools such as correlation coefficients, linear regressions and boxplots to analyse results. The results will continue with the general flow of the study and will start off by investigating water quality testing. The next section will be the results and analyses of the water quantity measuring, followed by the water quality results and water quantity baselines, benchmarks, correlations and linear regressions. The final section of this displayed the results with regards to other management components such as stakeholder involvement, financial implications and monitoring of systems.

4.2 Water quality testing

4.2.1 Introduction

In this section of the chapter the author calculated the percentage of lodges in South Africa, Namibia and Botswana that do water quality analyses. The purpose of this analyses was to determine if water quality testing is better in certain countries compared to others. The author also compared the tests results against the required testing parameters to benchmark the quality of the water. It was also important to identify challenges with regards to water quality testing to ensure continuous improvement of water management systems.

4.2.2 Results, discussion and analyses

Testing water at the source is an important sample point as it would determine the processes and treatment required for water to be consumed by humans at the lodge. It will also over a period of time indicate whether there was a decrease or increase in the water quality which could determine what amendments are required to keep water quality fit for human consumption at the lodge. As illustrated in figure 4.1, the results indicate that 50% of the lodges in South Africa had water quality analyses done on their water source.

In Namibia none of the lodges had water quality results at the source whereas 33% of the lodges in Botswana had water quality results on their source. This result thus states that the majority of the lodges across the three countries do not test the quality of their water source. This could have impacts on the success of the water purification and treatment processes as the treatment processes are generic rather than specific to treatment needs of the specific supply.

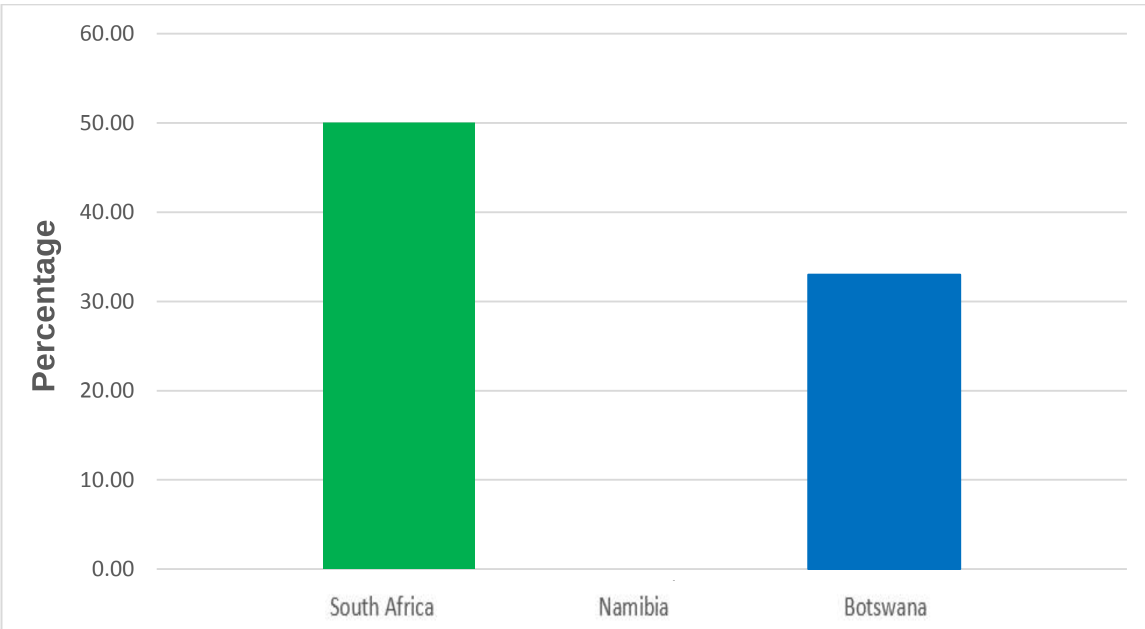

Figure 4.1: Percentage of lodges that conducted water quality analyses at their source.

Tap water is also an important sample point as this is the end point where guests and staff obtain water for their consumption. It is also an important indicator whether the treatment processes were successful and to determine if contamination occurs during the transfer of the water from the treatment plant to the end point. The results are illustrated in figure 4.2.

In South Africa, 88% of the lodges had their tap water quality analysed. In Namibia 75% of the lodges had their tap water quality analysed whereas only 33% of the lodges in Botswana had done water quality analyses on their tap water. An observation at the lodges from Namibia was that 50% of the lodges had the exact same results for either two or three years in a row for all the parameters, strongly suggesting that the results were copied and pasted from the first analysis. This jeopardises the credibility of the results and the supplier.

Wastewater is another crucial sample point as it could have negative impacts on water courses such as eutrophication. It can have negative impacts on the environment and alter micro-ecosystems due to contaminants. With regards to wastewater quality, 75% of the lodges in South Africa had done wastewater quality. None of the lodges in Namibia or Botswana had done water quality analyses on their wastewater.

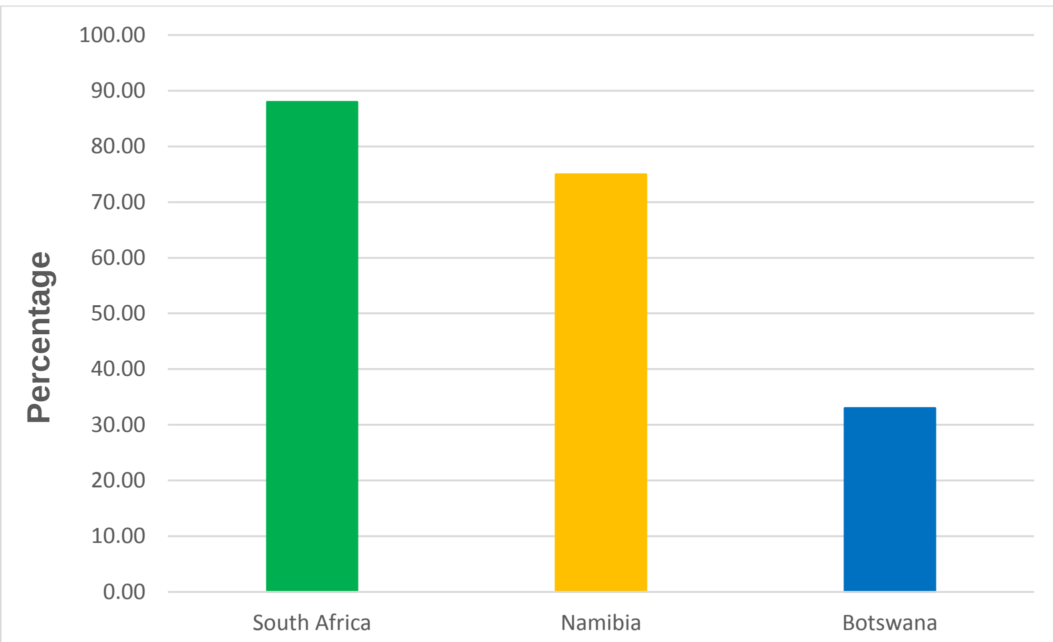

Figure 4.2: Percentage of lodges that conducted water quality analyses at their tap.

The water quality results were compared against the relevant country's national water standard for drinking water and wastewater discharge. The number of parameters that were tested in the analyses were compared against the required number of parameters stated in the relevant standards. In South Africa, three different service providers were used at various lodges, each testing their own set of parameters. In Namibia, all seven lodges used the same service provider and thus the results were universal for all seven lodges. The same was applicable for the five lodges in Botswana. Table 4.1 below states the results of this investigation with regards to drinking water whereas Table 4.2 states the results with regards to wastewater discharge.

Although 88% of the lodges in South Africa had their tap water quality analysed, only 25% lodges in the country tested more than 26% of the required parameters.

Table 4.1: Drinking water parameters tested vs parameters required

Country	No of lodges	Standard	Parameters tested	Parameters required	% tested
South Africa		SANS:241:2015			
Service provider 1	4		9	47	19%
Service provider 2	2		35	47	74%
Service provider 3	1		12	47	26%
Namibia	7	The Water Act (56 of 1956)	20	54	37%
Botswana	9	BOS 32:2009	16	57	28%

All seven lodges in Namibia tested only 37% of the required parameters for drinking water. Again, these reports are quite poor due the majority of the parameters not being tested. An observation with the Namibian results is that there were no microbiological analyses, only chemical analyses. This could be due to limitations from the supplier and / or laboratory in the region. However, the exact cause why there were no microbiological analyses is not covered in this study and would require further investigation.

The five lodges in Botswana only tested 28% of the required parameters for drinking water. According to a staff member the lodges had their water analysed at a university in Maun by students under supervision of university staff. The name of the university or supervisor was not disclosed by the staff member. Not only are the results poor due the majority of the parameters not tested, the analyses are also not done by qualified, experienced professionals which effects the credibility of the results. According to the same staff member, there are no other water quality facilities in the province. This and other logistical challenges such as the remote locations in Botswana with limited infrastructure makes water quality testing near impossible. The author verified this information on his site visits and can appreciate the effort from the lodges that attempted to have water quality tested.

Table 4.2: Wastewater parameters tested vs parameters required

Country	No of lodges	Standard	Parameters tested	Parameters required	% tested
South Africa		National Gazette No 36820, 6 Sep 2013			
Service provider 1	4		2	5	40%
Service provider 2	2		37	5	100%
Namibia		Guidelines (461/85)	0	26	0%
Botswana		BOS 93:2004	0	34	0%

Of the six lodges in South Africa that tested wastewater discharge, two complied 100% with the requirements and exceeded the required amount of parameters, whereas four lodges tested 40% of the required parameters. This means that the wastewater quality results are inconclusive at these four lodges and that the author could not establish whether the wastewater quality complies with legal requirements. The lodges can also not determine the efficiency of their wastewater plant as there is no results to indicate that the plant is operating successfully.

4.2.3 Summary of water quality testing results

The results indicate that 88% of the lodges in South Africa do engage in water quality analysis of their tap water, however, only 25% of those lodges tested more than 26% of the relevant standard of their drinking water. Although the water quality will be analysed later, there is no certainty in concluding that the lodge water quality is safe for human consumption at all the lodges in South Africa. The same applies for Namibia as well as

Botswana. In Namibia there were no microbiological tests and in Botswana only 28% of the required parameters were tested. Although many lodges supply their guests with bottled water, the concern is the water supply to the staff. In South Africa, staff residing on the premises activates section 8 of the National Occupation Health and Safety act, which states: "*Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees*". It is therefore highly recommended that the lodges in all three countries engage in more conclusive and more frequent water quality testing to ensure the safety of their staff as well as guests.

4.3 Water quantity measuring

4.3.1 Introduction

In this section of the chapter the author investigated the water consumption data. The purpose of this was to identify how many lodges do comply with the organisations' management policy of measuring water quantity monthly. It was also important to identify challenges the lodges might have with regards to measuring water quantity and to provide recommendations applicable to ensure continuous improvement.

4.3.2 Results, discussion and analyses

The results state that 25% (2) of the lodges in South Africa recorded water consumption data as per the organisations management procedures. In Namibia the record keeping was more consistent with 88% (7) of the lodges recording water consumption data for all the months during the study period. In Botswana 73% (11) of the lodges had complete sets of water quantity data. The results are illustrated in figure 4.3.

Figure 4.4 indicates that 25% (2) of the lodges in South Africa had one or two months of missing data whereas 7% (1) of the lodges in Botswana had the same number of water quantity datasets outstanding.

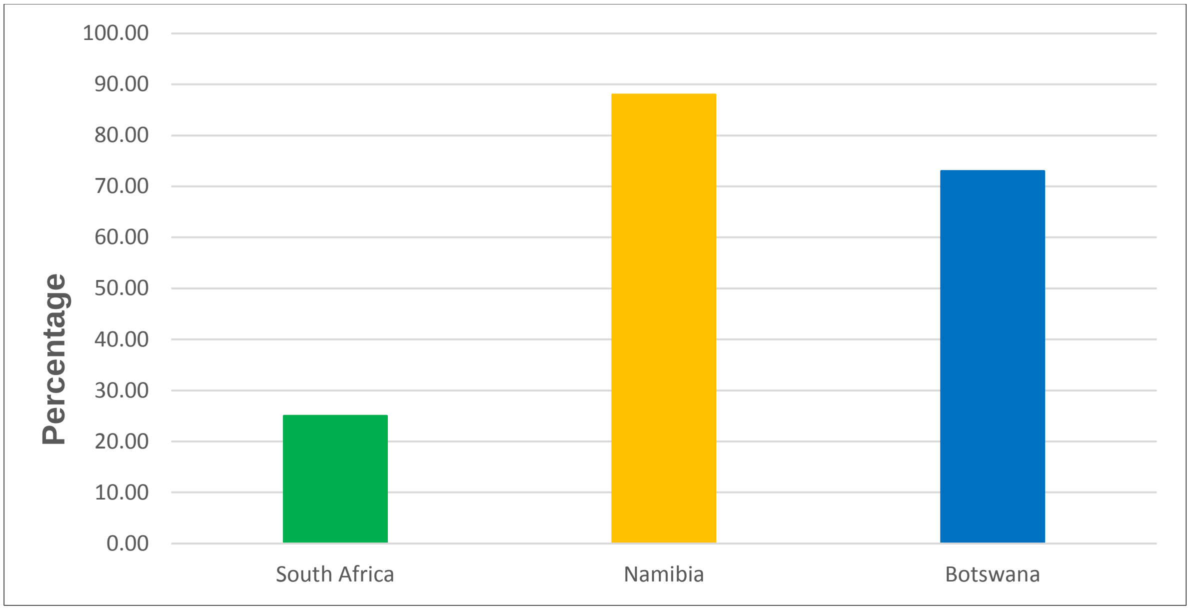

Figure 4.3: Percentage of lodges with complete sets of water quantity data

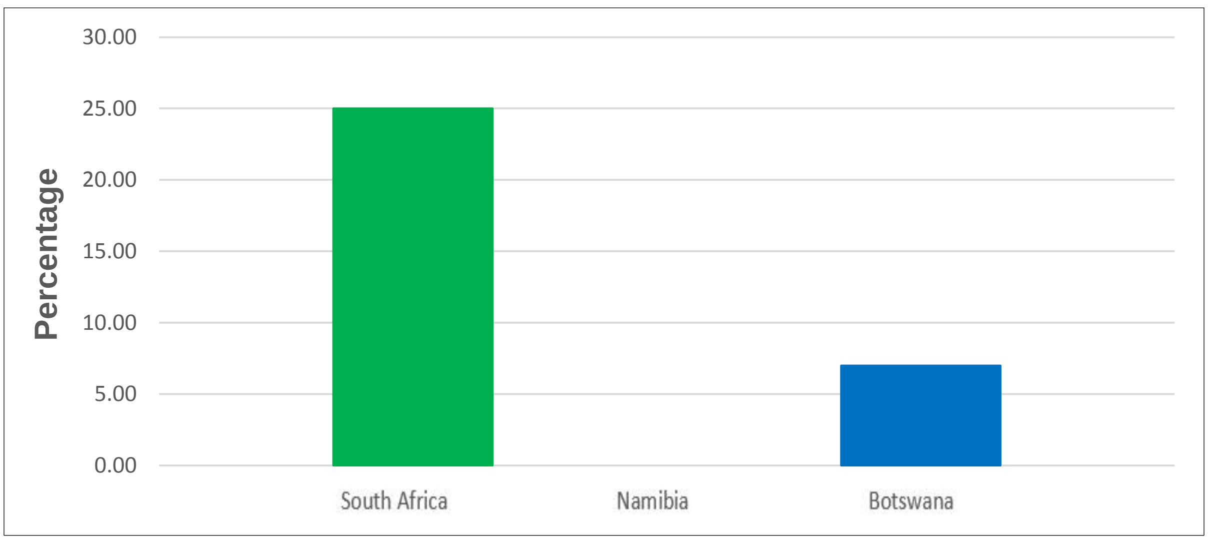

Figure 4.4: Percentage of lodges with 1-2 months of missing water quantity data

Figure 4.5 illustrates that 50% (4) of the lodges in South Africa had three or more months of missing data. In Namibia the record keeping was more consistent, with only 12% (1) of the lodges missing three or months of data. In Botswana 20% (3) of the lodges had three or more months of missing data.

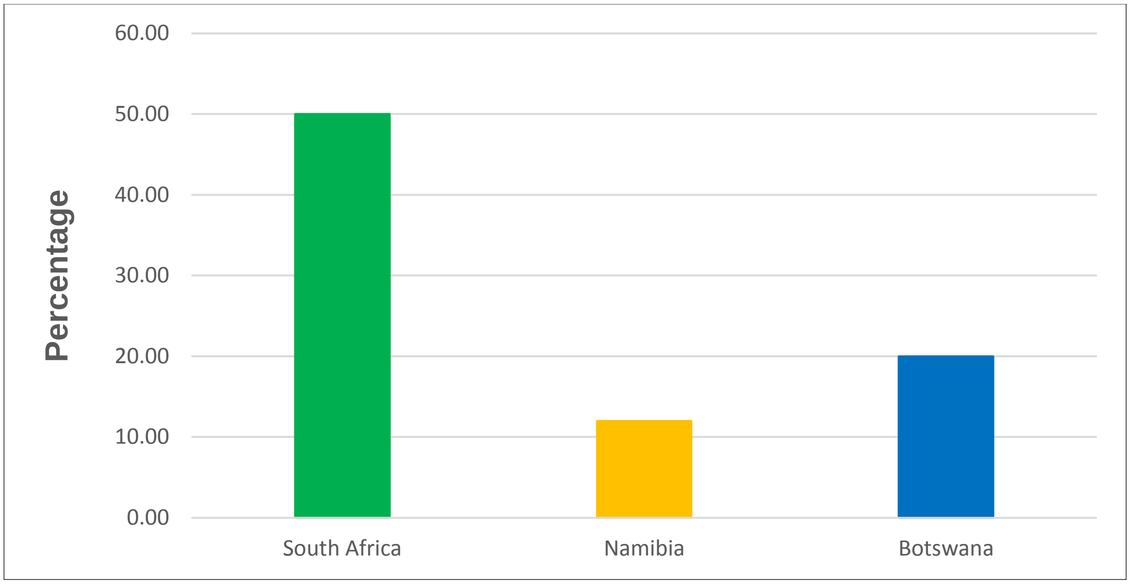

Figure 4.5: Percentage of lodges with 3 or more months of missing data

During the interviews it became evident that at certain lodges the water quality is of such poor quality that it causes water meters to seize up. Since the lodges are situated in remote areas, this could be the reason that certain lodges had missing datasets as they could not immediately replace water meters. Another challenge is that staff work on a rotational program. The most common forms of this rotational program is either three and one or six and two, meaning that staff as well as management work uninterruptedly for either three or six weeks, where after they are off duty (and off the premises) for either one or two weeks. This could result in the person being responsible for taking readings at the end of the month might not be on duty or on the premises. Although these reasons are only speculation, the exact reasons why 75% (6) of the lodges in South Africa, 12% (1) of the lodges in Namibia and 27% (4) of the lodges in Botswana had missing data was not investigated in this study and do require further investigation.

4.3.3 Summary of water quantity measuring

Complete sets of water consumption data was available at 65% of the lodges across all three countries. The results strongly suggests that there are opportunities to improve the consistency and accuracy of water quantity data, especially in South Africa where 75% of the lodges did not have complete sets of data. Improved technology can aid in instances where water meters seize up and lodges can use pulse meters instead of flow meters. Smart water meters with integrated WIFI can be used to capture recordings as this will eliminate problems such as staff being off duty or absent. Further investigation as to why lodges fail to consistently measure water consumption is required to identify other challenges not stated in this study.

4.4 Water quality results and compliance

4.4.1 Introduction

The importance of water quality has been well defined earlier in this study. In this section of the chapter the author selected eight important parameters from the water quality reports from the lodges in all three countries. The author also stated the associated aesthetic and human health effects from each microbial-, micro- and macro-determinant. The results were also measured against the corresponding country's standard or guideline to determine if the water quality is suitable for human consumption. Although the Namibian guideline for drinking water has four categories (see Appendix D), only category A was used in all the figures in this section. Where a result exceeded the limit of category A, the author referred to the other categories to determine whether the water would be suitable for human consumption or not. Only the tap water quality results were used in this section. The reason for this is a result of the limited number of water analyses conducted on the source and the wastewater sample points.

4.4.2 Results, discussion and analyses

Only in the cases where determinants were measured were used in this discussion. Only one year's (2016) quality reports were used in the analyses due to unreliable data and different parameters tested from one year to another. The following parameters were analysed:

- pH

The pH in water is the measurement to determine whether the water is acidic, alkaline or neutral. Although no health effects are associated with pH, it plays an important role in the treatment of water, especially water clarification and disinfection. For effective disinfection with chlorine, the pH should preferable be less than eight (8) (DWAF, 1996).

The taste of water, its corrosive potential and the solubility and speciation of metal ions are all influenced by pH. At a low pH water may taste sour, while at high pH water tastes bitter or soapy. The potential toxicity of metal ions and chemicals which can be protonated, for example ammonia, is influenced by pH. Changes in pH affect the degree of dissociation of weak acids and bases (DWAF, 1996). This effect is of special importance because the toxicity of many compounds are affected by their degree of dissociation. The pH results from the lodges in South Africa, Namibia and Botswana are illustrated in figure 4.6.

The results state that the pH of the water at all the lodges were compliant with the relevant countries' standard or guideline. Lodge S3, S4 and N7 all had pH levels above eight, meaning that slight treatment is required to ensure more efficient and successful disinfection. An interesting observation was that all the pH levels from Botswana were below six (slightly acidic), whereas the pH levels from South Africa and Namibia were all above seven. Carbon dioxide is a common cause of acidity in water and photosynthesis, respiration and decomposition all influence carbon dioxide levels. Considering the enormous amount of aquatic vegetation in the Okavango Delta, it is most likely the cause for the acidity in the Botswana water (DWAF, 1996).

The slightly acidic water will accelerate corrosion in metallic plumbing systems. This could lead to an increase of iron and / or copper levels in the water which could be harmful to humans in the form of metal toxicity. The increase of dissolved metals in the water will also cause stains to enamel surfaces such as toilets and hand basins. It may also cause orange-brown stains on laundry which will result in more frequent replacing of sheets and linen. It is thus advisable for lodges in the Okavango Delta to manipulate the pH as soon as possible to limit water circulation or to consider other alternatives such as Polyvinyl chloride (PVC) piping instead of metal piping. PVC piping is not known to be affected by acidic water and would be a good alternative, even in the planning phase, to mitigate the potential harm of the slightly acidic water in Okavango Delta.

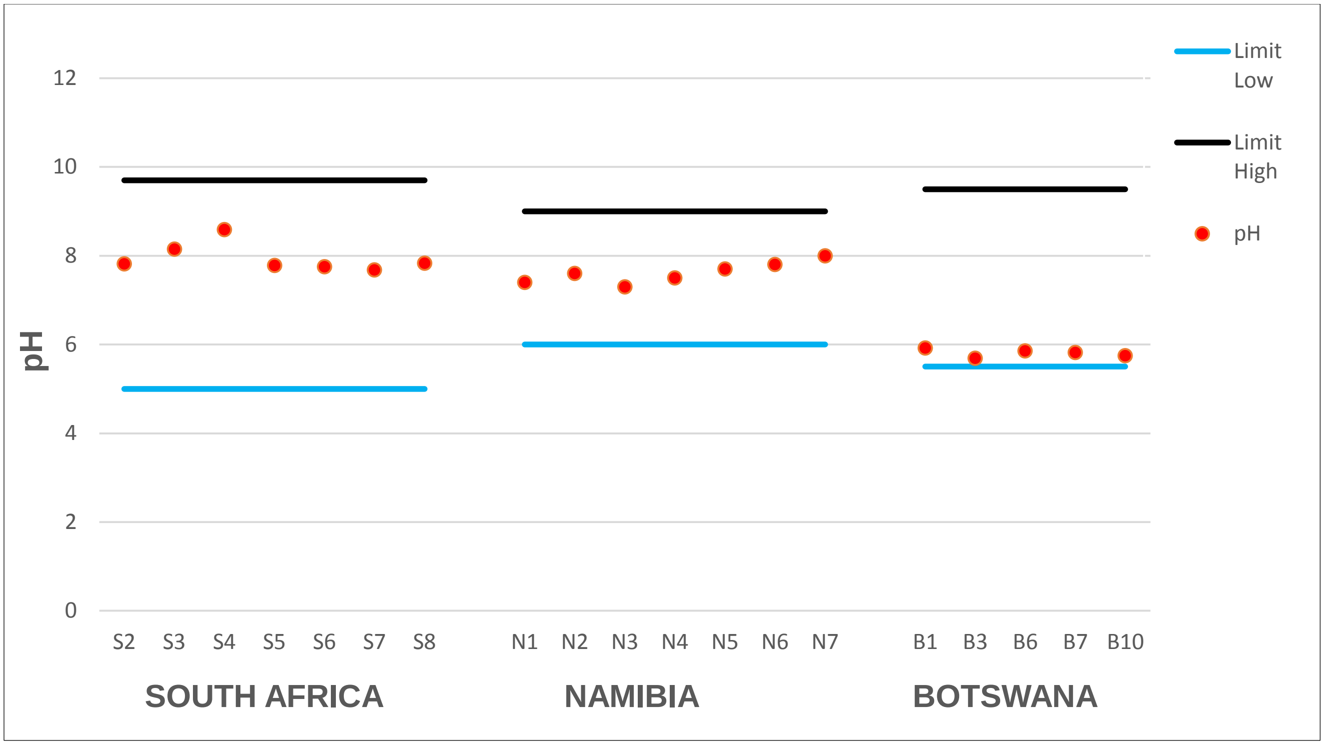

Figure 4.6: pH levels from lodges in South Africa, Namibia and Botswana

- Conductivity

Conductivity is the measurement to determine the transmission of electrical current in water and is an indicative of the total dissolved solids in the water. High conductivity can lead to a “mineral taste” in water and can cause severe scaling in piping and heating equipment such as geysers and kettles. No adverse health effects are associated directly to high conductivity (DWAF, 1996). The results are illustrated in figure 4.7.

The results indicate that conductivity levels are within the relevant countries’ standard or guideline, with the exception of lodge S3, N3, N4 and N7. The water from lodge S3 is unsuitable for human consumption based on the SANS 241: 2015 standard. Both lodge N3 and N4 were within category C of the Namibian guidelines, resulting that there is low health risk associated with conductivity levels in the water. Lodge N7 fell into category B, which states that the water is of acceptable quality, however not excellent.

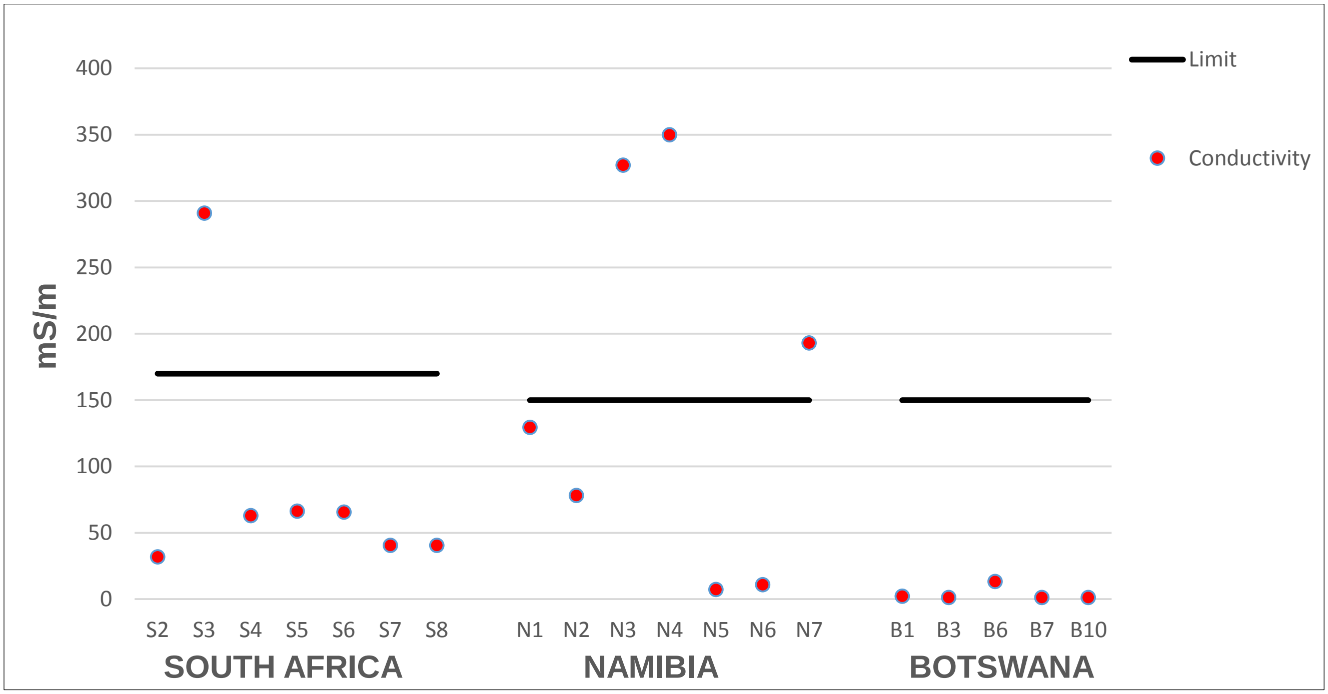

Figure 4.7: Conductivity levels from lodges in South Africa, Namibia and Botswana

- Total Dissolved Solids (TDS)

The total dissolved solids (TDS) is a measure of the amount of various inorganic salts dissolved in water. The TDS concentration is directly related to the electrical conductivity of water. Since conductivity is much easier to measure than TDS, it is routinely used as an estimate of the TDS concentration. The Namibian standard does not provide a limit for TDS, most likely due to the direct relation with conductivity. The TDS results are illustrated in figure 4.8.

The results indicate the relation between TDS and conductivity as the same lodges exceeded the standard limits. Although there is no limit for the Namibian lodges, since the conductivity exceeded the limit for lodge N3, N4 and N7, the same will apply for TDS. It can therefore be assumed that lodge N3 and N4 would be within category C of the Namibian guidelines, resulting that there is low health risk associated with the TDS levels in the water. Lodge N7 would fall into category B, which states that the water is of acceptable quality, however not excellent

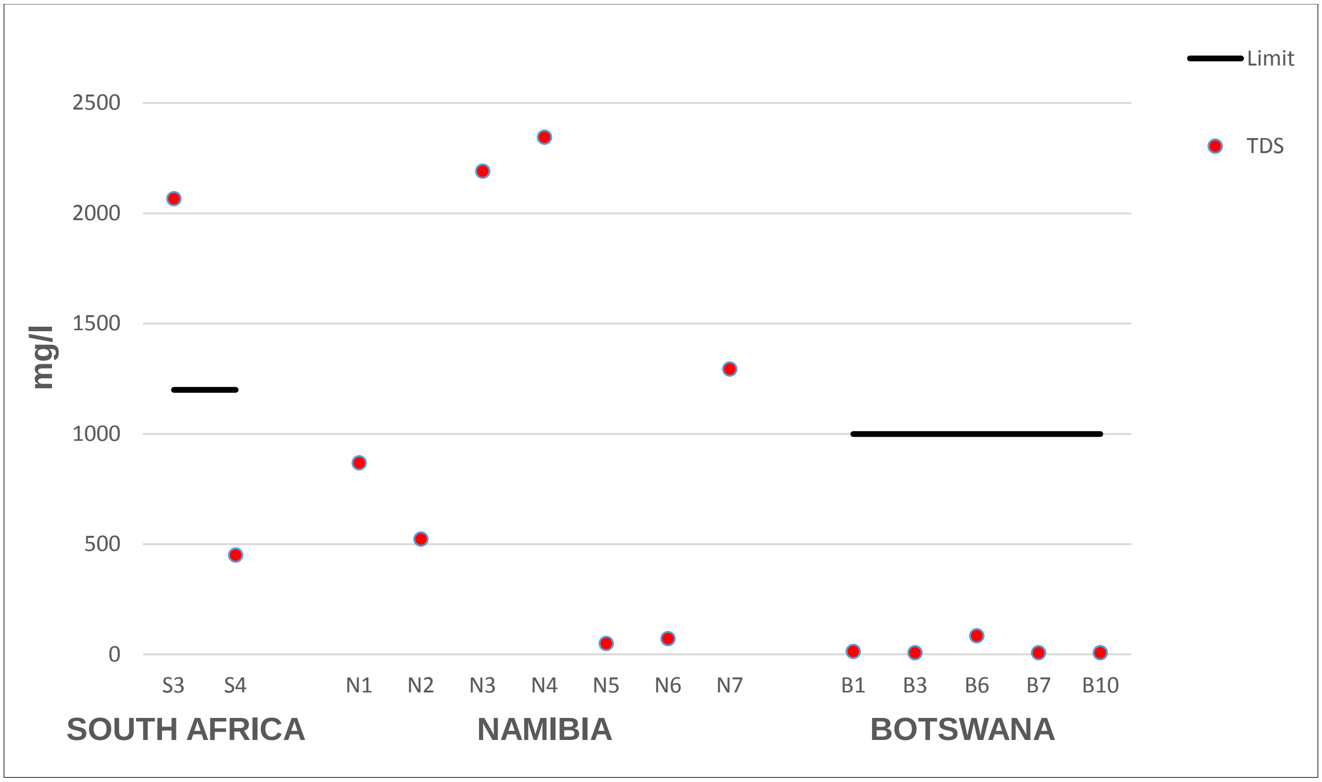

Figure 4.8: TDS levels from lodges in South Africa, Namibia and Botswana

- Nitrate

Nitrate (NO_3) are natural occurring ions that form part of the Nitrogen cycle. It is commonly used in inorganic fertilizers. It is also used as an oxidizing agent in the manufacturing of explosives and purified potassium nitrate is used for glass making. Sodium nitrite is used as a food preservative, especially in cured meats. Nitrate in water is undetectable without testing because it is colourless, odourless, and tasteless. Upon absorption, nitrate combines with the oxygen-carrying red blood pigment, haemoglobin, to form methaemoglobin, which is incapable of carrying oxygen. This condition is termed methaemoglobinaemia (DWAF, 1996). The reaction of nitrate with haemoglobin can be particularly hazardous in infants under three months of age and is compounded when the intake of Vitamin C is inadequate. According to DWAF (1996) the effects of Nitrate are tabled in Table 4.3 below whereas the results are illustrated in figure 4.9.

Table 4.3: The effects of Nitrate on human health (DWAF, 1996)

Nitrate range as N mg/L	Effects
0 – 6	No adverse health effects
6 – 10	Rare instances of methaemoglobinaemia in infants; no effects on adults. Concentrations in this range generally well tolerated
10 – 20	Methaemoglobinaemia may occur in infants. No effects in adults
>20	Methaemoglobinaemia occurs in infants. Occurrence of mucous membrane irritation in adults

The results indicate that the Nitrate levels at all the lodges were well within the limit as per guidelines or standards. Only one lodge in South Africa (S2) had the Nitrate levels in their water analysed.

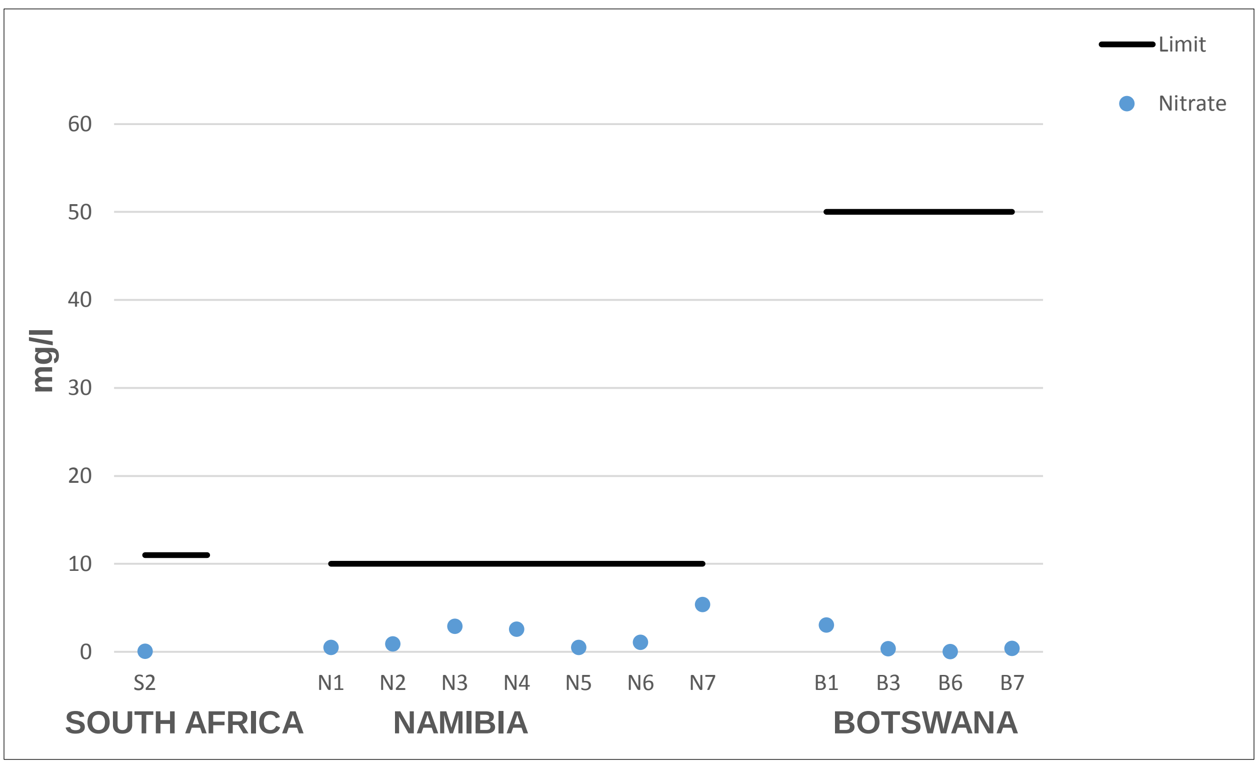

Figure 4.9: Nitrate levels from lodges in South Africa, Namibia and Botswana

- Sulphate

Sulphate (SO_4) is the oxi-anion of the element Sulphur and occurs commonly in groundwater. As water moves through soil and rock formations that contain sulphate minerals, some of the sulphate dissolves into the groundwater. It is also an indication of pollution such as mine drainage and effluent return flows which contains high levels of Sulphate. High levels of Sulphate can give water a bitter or astringent taste and can have adverse health effects, causing diarrhoea. Sulphate accelerates corrosion in piping and can cause metals to leach into the water (DWAF, 1996). According to DWAF (1996), table 4.4 below state the effects of Sulphate on aesthetics and human health whereas figure 4.10 illustrates the results.

Table 4.4: The effects of Sulphate on aesthetics and human health (DWAF, 1996)

Sulphate range as SO_4 mg/L	Effects
0 – 200	No health or aesthetic effects are experienced
200 – 400	Tendency to develop diarrhoea in sensitive and some non-adapted individuals. Slight taste noticeable
400 – 600	Diarrhoea in most non-adapted individuals. Definite salty or bitter taste
600 - 1000	Diarrhoea in most individuals. User-adaptation does not occur. Pronounced salty or bitter taste
>1000	Diarrhoea in all individuals. User-adaptation does not occur. Very strong salty and bitter taste

The results indicate that the lodges that did test for sulphate levels in South Africa and Botswana were well within the limit of the relevant standards. The majority of the lodges in Namibia exceed the category A limit. Although the sulphate levels from lodge N1, N4 and N7 falls within category B (acceptable water quality) of the Namibian standard, table 4.4 above suggest that diarrhoea may occur in sensitive and non-adapted users. The sulphate level from lodge N3 fell within category C, which relates to a low health risk associated with the sulphate level and according to table 4.4 may lead to diarrhea.

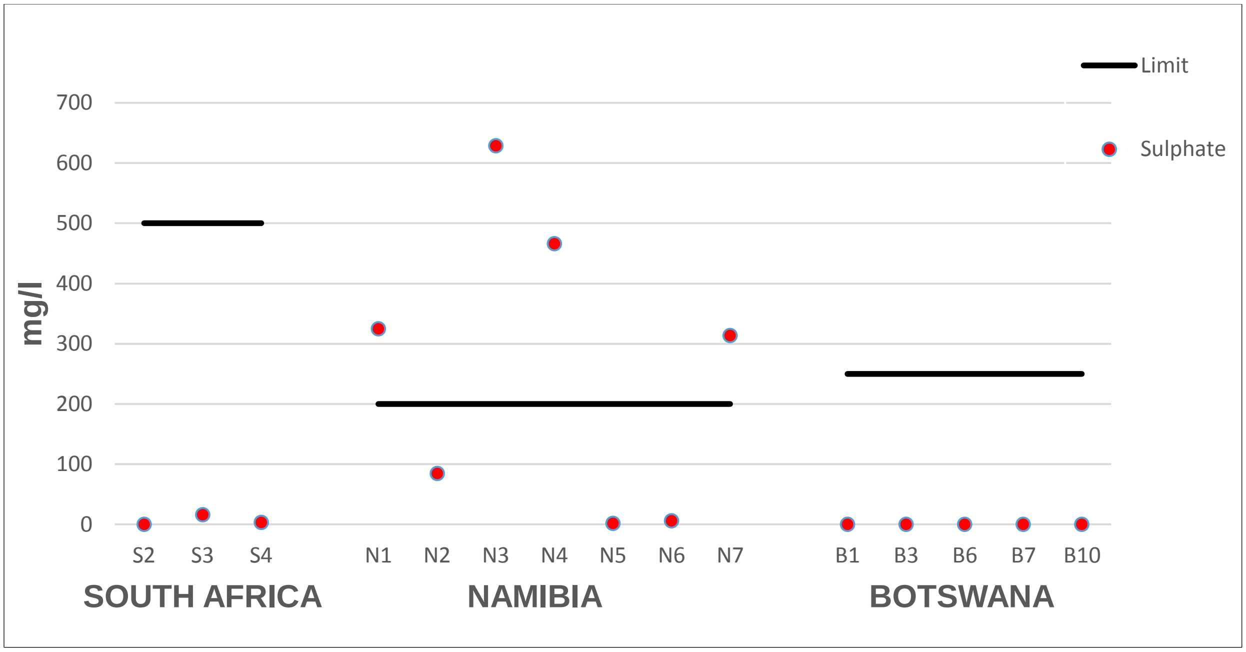

Figure 4.10: Sulphate levels from lodges in South Africa, Namibia and Botswana

- Iron

Pure iron is silvery in colour but usually appears as greyish black or brown deposits as a result of oxidation. Biologically iron is an essential micronutrient required by all living organisms. High concentrations of iron are predominantly an aesthetic concern since ferrous salts are unstable under the pH conditions prevailing in drinking water and precipitate as insoluble ferric hydroxide, which settles out as a rust-coloured silt. Excessive ingestion of iron may result in haemochromatosis, wherein tissue damage occurs as a consequence of iron accumulation. Haemochromatosis generally results from prolonged consumption of acid foodstuffs cooked in kitchenware made of iron. Poisoning is rare since excessively high concentrations of iron do not occur naturally in water. The extreme unpalatability of such water would probably prevent consumption. Further, iron in the distribution system promotes proliferation of iron-oxidising bacteria which oxidise ferrous iron to ferric iron, and manifest as slimy coatings in plumbing when the iron concentration of the water in the distribution system approaches 0.3 mg/L. Effects are predominantly aesthetic, such as the staining of enameled surfaces of baths, hand basins and lavatory cisterns/bowls and laundry (DWAF, 1996). According to DWAF (1996) the effects of Iron are stated in Table 4.5 below whereas the results are illustrated in figure 4.11.

Table 4.5: Effects of Iron on aesthetic and human health (DWAF, 1996)

Iron range as Fe mg/L	Effects
0 – 0.1	No taste, other aesthetic or health effects associated with consumption and use.
1 – 3	Very slight effects on taste and marginal other aesthetic effects. Deposits in plumbing with associated problems may begin to occur. No health effects; the water is generally well tolerated
3 – 10	Adverse aesthetic effects (taste) gradually increase as do possible problems with plumbing. No health effects
10 – 100	Pronounced aesthetic effects (taste) along with problems with plumbing. Slight health effects expected in young children, and sensitive individuals
100 – 300	Severe aesthetic effects (taste) and effects on the plumbing (slimy coatings). Slight iron overload possible in some individuals. Chronic health effects in young children and sensitive individuals in the range 100 – 200 mg/L, and occasional acute effects toward the upper end of this range.

The results indicate that all the lodges that tested for Iron, with the exception of lodge N5 (category B, acceptable water quality), N2 (category C, low health risk) and B6 (not fit for human consumption), the iron levels were within the relevant standards or guidelines.

According to table 4.5, the iron levels at lodge N2 and B6 will have a slight effect on the taste of the water and could lead to deposits in the plumbing system which will accelerate corrosion in metallic plumbing systems.

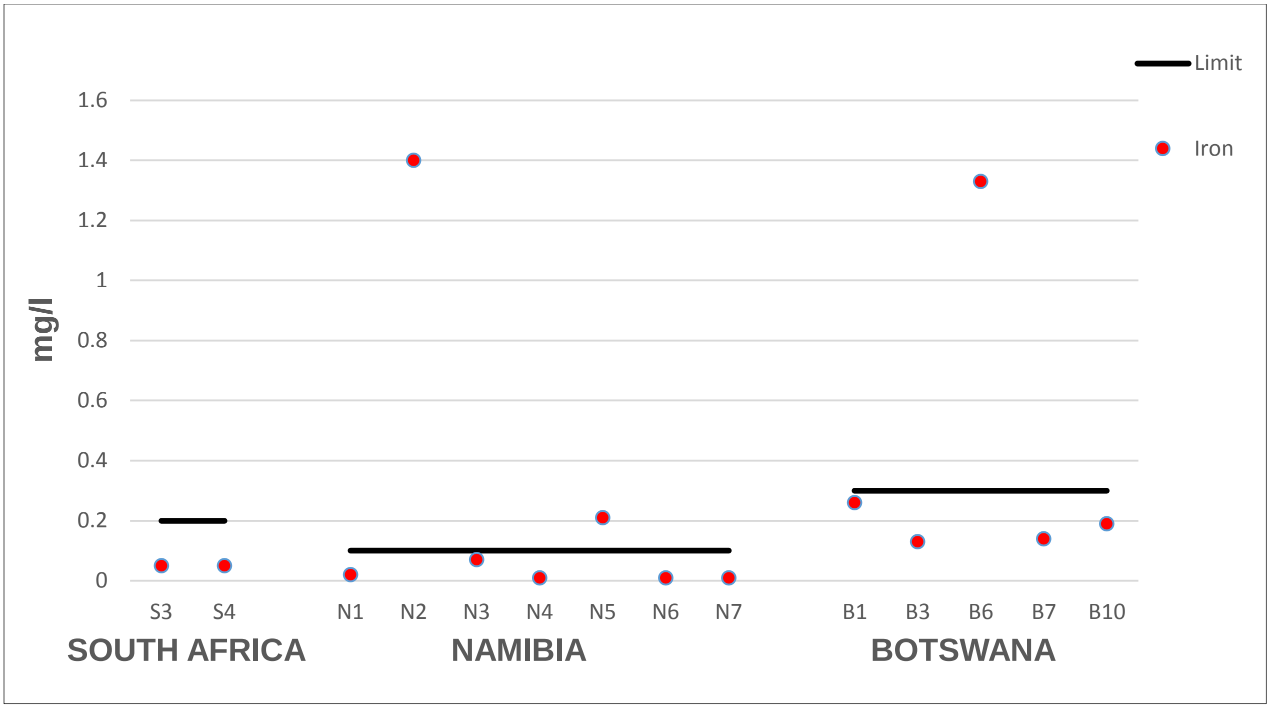

Figure 4.11: Iron levels from lodges in South Africa, Namibia and Botswana

- Chloride

Chloride is the negative ion (anion) of the element Chlorine and is commonly found in ground water. It generally combines with calcium, magnesium, or sodium to form various salts such as sodium chloride (NaCl). Although chlorides are harmless at low levels, groundwater with high levels of sodium chloride can damage vegetation if used for gardening or irrigation, and give drinking water an unpleasant taste. Over time, sodium chloride's high corrosion properties will also damage plumbing, appliances, and water heaters, causing toxic metals to leach into the water (DWAF, 1996). Chloride toxicity has not been observed in humans except in special cases of impaired sodium chloride metabolism, e.g. in congestive heart failure. Healthy individuals can tolerate the intake of large quantities of chloride provided that there is a concomitant intake of fresh water. According to DWAF (1996) the effects of Chloride on aesthetics, household distribution systems and appliances and human health are stated in Table 4.6 whereas the results are illustrated in figure 4.12.

Table 4.6: The effects of Chloride on aesthetics, household distribution systems and appliances and human health (DWAF, 1996)

Chloride range mg/L	Effects
0 - 100	No aesthetic or health effects. The threshold for corrosion acceleration in domestic appliances is at 50 mg/L
100 - 200	No aesthetic or health effects. Possible increase in the corrosion rate in domestic appliances
200 - 600	Water has a distinctly salty taste, but no health effects Likelihood of noticeable increase in corrosion rates in domestic appliances
600 - 1200	Water has objectionable salty taste and will not slake thirst. Likelihood of rapid corrosion in domestic appliances
>1200	Water unacceptably salty. Nausea and disturbance of the electrolyte balance can occur, especially in infants, where fatalities due to dehydration may occur.

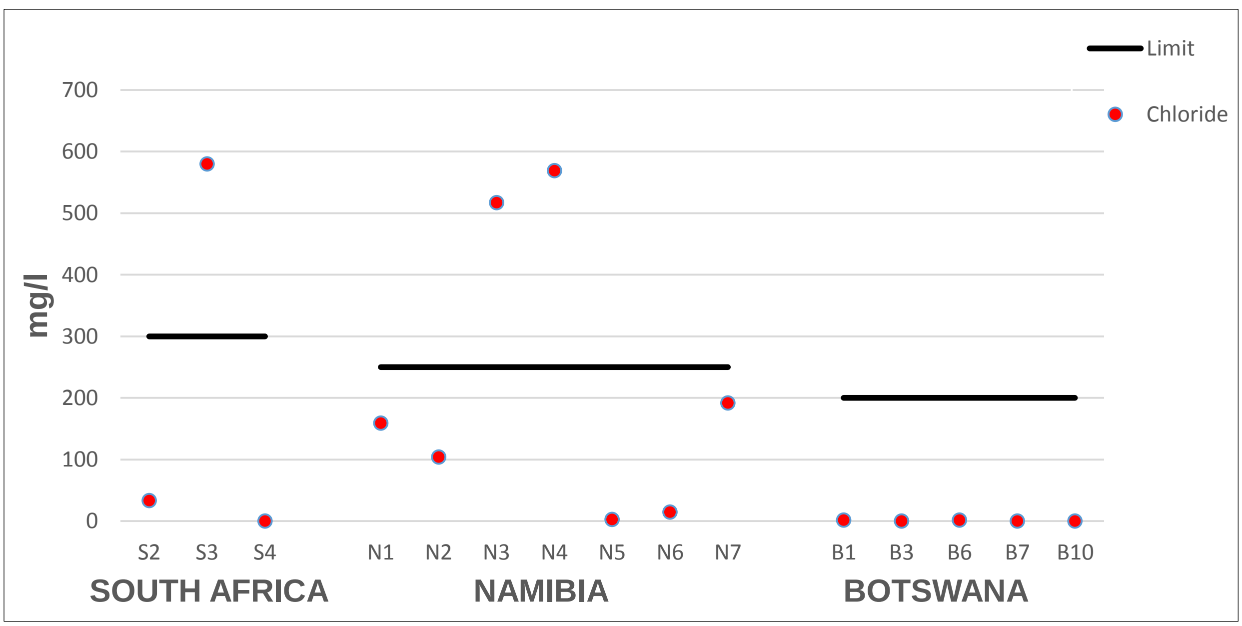

Figure 4.12: Chloride levels from lodges in South Africa, Namibia and Botswana

The results indicate that the chloride levels at most of the lodges were within the relevant standards or guidelines. Although the chloride levels from lodge N3 and N4 were outside category A, it still fell within category B resulting in accepted water quality. The water from lodge S3 is unsuitable for human consumption in South Africa due to the SANS 241: 2015 limit. The chloride levels at all the lodges in Botswana were well within the limit.

- *Escherichia coli (E coli)*

Escherichia coli, more commonly known as only *E coli*, is a bacteria that origins from the faeces of humans and other warm blooded animals. Many different strains of *E coli* exist and more than 700 serotypes have been identified. The most common and dangerous serotype is *E coli* 0157:H7. Common diseases associate with *E coli* is gastrointestinal infections, diarrhoea, nausea and vomiting. In some people, particularly children under 5 years of age and the elderly, the infection can also cause a complication called hemolytic uremic syndrome, in which the red blood cells are destroyed and the kidneys fail. About 2% - 7% of infections lead to this complication. Symptoms usually appear within 2 to 4 days, but can take up to 8 days. Water containing *E coli* can be easily disinfected by adding Calcium hypochlorite (swimming pool chlorine) or Sodium hypochlorite (chlorine bleach) (DWAF, 1996). Another method to eliminate *E coli* is through an ultra violet (UV) light. The results are illustrated in figure 4.13.

The results indicate that no *E coli* were detected at any lodges that tested for the bacteria, resulting in complying with the relevant standards. None of the lodges in Namibia had their water tested for the presence of *E. coli*.

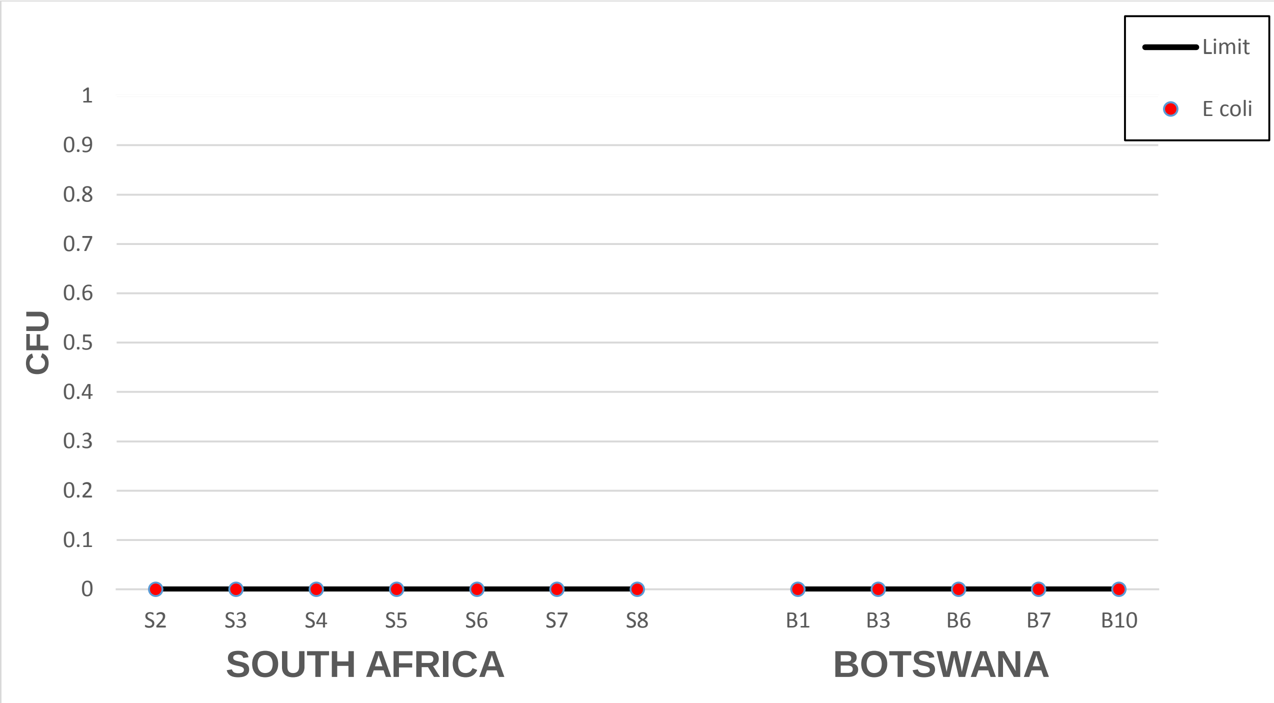

Figure 4.13: *E. coli* results from lodges in South Africa and Botswana

- Total coliforms

Coliform bacteria are a natural part of the microbiology of the intestinal tract of warm blooded mammals, including man. Coliform bacteria can also be found in soil, other animals, insects, etc. Total coliform bacteria refer to all bacteria which produce colonies with a typical metallic sheen within 20 -24 hours of incubation at 35ºC. These tests provide an indication of the general sanitary quality of water since many of the bacteria in this group are from faecal origin. If large numbers of coliforms are found in water, there is a high probability that other pathogenic bacteria or organisms, such as *Giardia* and *Cryptosporidium*, may be present. Water containing coliforms can be easily disinfected by adding Calcium hypochlorite (swimming pool chlorine) or Sodium hypochlorite (chlorine bleach). Another method to eliminate coliform bacteria is through an ultra violet (UV) light. The results are illustrated in figure 4.14.

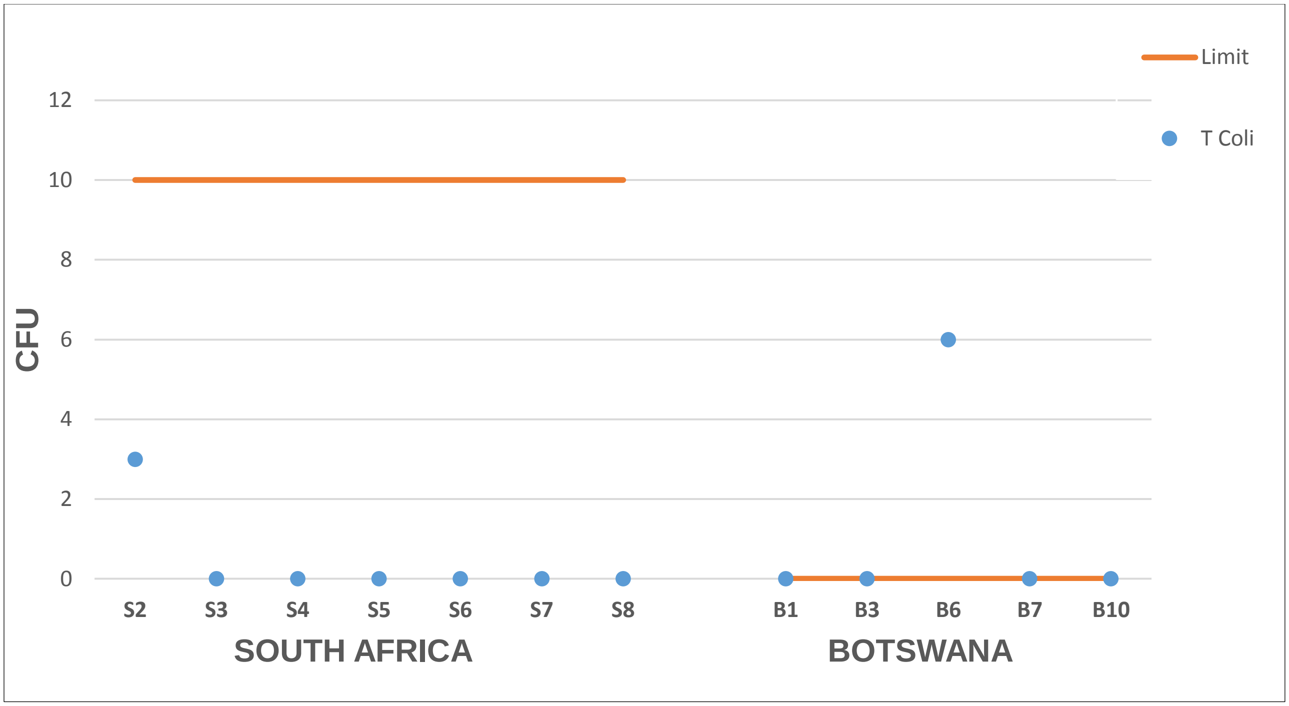

Figure 4.14: Total coliform results from lodges in South Africa, Namibia and Botswana

The results indicate that coliform bacteria were detected at lodge S2 as well as B6. The limit in South Africa for coliform bacteria is 10 CFU, meaning that the water from lodge S2 is still suitable for consumption. In Botswana the limit is 0 and therefore the water at lodge B6 does not comply with the standard requirements. No coliform bacteria were detected at any of the other lodges.

4.4.3. Summary of water quality results

Although the pH levels at all the lodges were within the limits, it is recommended that the lodges treat the pH to be as close to 7 as possible, especially the lodges the pH levels of above 8. This will ensure more effective treatment of the water especially with regards to disinfecting the water. Digital pH / TDS combo meters can be bought for less than R 500. This will allow the lodges to monitor the pH levels themselves and will ensure that the pH can be monitored more regularly.

The conductivity and TDS in the water at the majority of the lodges were within the limits. The high conductivity levels will affect the taste of the water and could cause damage to piping and heating elements. The most common way to reduce TDS and conductivity is through a reverse osmosis system. Other alternatives are distillation and de-ionizing.

The nitrate levels at the lodges were all within the required limits and do not require any treatment. Several lodges had issues with Iron, Sulphate and Chloride levels. Iron can be treated by an oxidizing process which will removed the particles through filtration. This can be achieved by devices such as fountains or chemically oxidized by dosing the water with chlorine or hydrogen peroxide. Chloride levels can be lowered through electrolysis or desalination techniques such as reverse osmosis. Desalination will also be effective to treat the high Sulphate levels (DWAF, 1996).

Although *E coli* were absent at all the lodges, two lodges had small amounts of coliform bacteria in their water. This can be treated by adding disinfectants such as Calcium hypochlorite (swimming pool chlorine) or Sodium hypochlorite (chlorine bleach). Since this is such an important parameter, it is recommended that the lodges test for bacteria regularly. Test kits can be purchased for less than R 600 and will give accurate results with regards to bacteria in the water.

4.5 Water quantity baselines and benchmarks

4.5.1 Introduction

In this section of the chapter the author presented, discussed and analysed the water quantity results from the data obtained. The water consumption baseline will refer to the average of the lodges analysed as specified. The benchmark that the author had used was the “best in class” method and will be the lowest water consumption per capita for the lodges as specified. The author first presents the results for all three countries combined before separating the countries.

The author used the international standard of litre per guest per night (l/g/n) as well as the recommendations made by Mearns and Grobler (2016) to include staff. The guest and staff usage was presented as litre per bed per night (l/b/n). According to Mearns and Grobler (2016) the international standard should not be applicable for the wildlife lodge industry in South Africa, Namibia and Botswana due to the major role staff play in water consumption, as well as the difference in characteristics of the specific tourism sector, especially with the regards to staff living on the premises whereas staff working in European hotels does not live on the premises.

4.5.2 Results, discussion and analyses

Figure 4.15 indicates the l/g/n per lodge in all three countries. The water quantity records for the past two years was used and the total water consumption for the 24 months was divided by the total number of guest nights over the same period to provide a two year average at each lodge. Lodges with blue values represent lodges from Botswana. Lodges with green values represent lodges from South Africa whereas lodges with a yellow value represent lodges from Namibia.

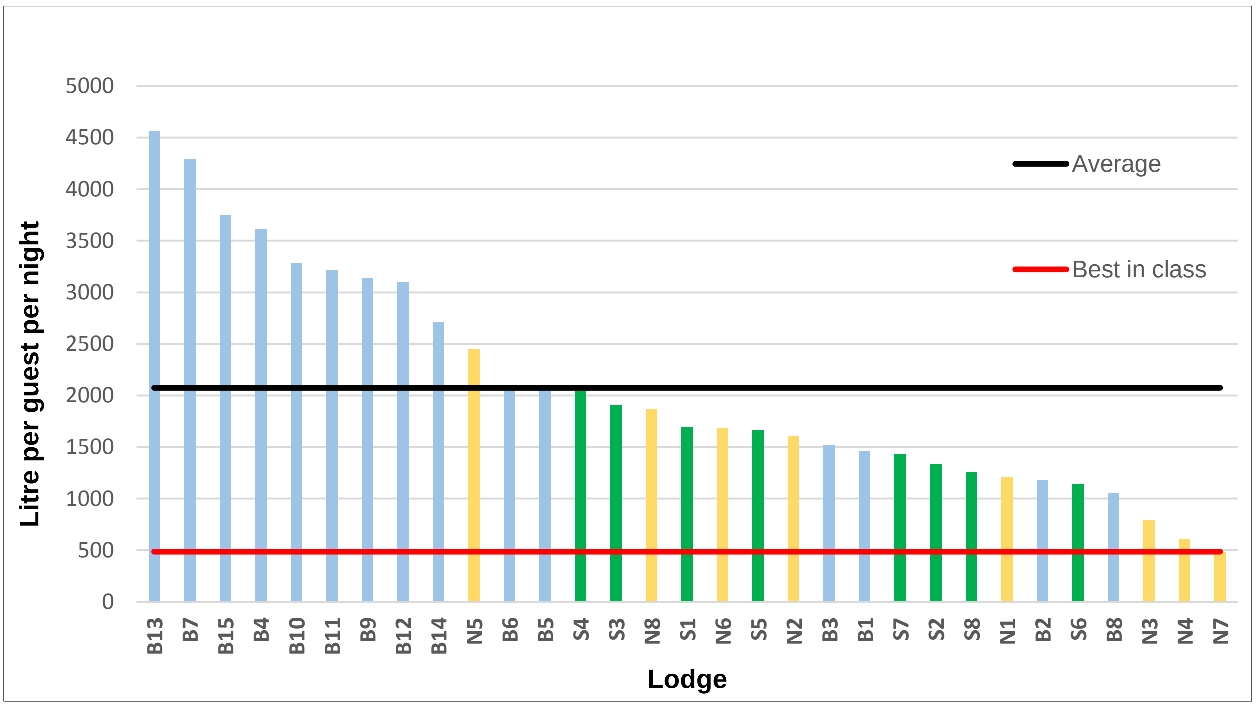

Figure 4.15: Litre per guest night from all the lodges in South Africa, Namibia and Botswana

The average consumption across the three countries was 2073 l/g/n. According to table 1, the average consumption for 5 star hotels in Greece and Morocco is 675 l/g/n and 500 l/g/n respectively. The average consumption for all types of accommodation in the Mediterranean range between 440 – 880 l/g/n. the average consumption for hotels in Zanzibar is 931 l/g/n. The results indicate that the average consumption across South Africa, Namibia and Botswana are in some instance three to four times than other countries across the globe. Table 1 states that countries such as the Philippines, Thailand and Hong Kong use up 3 198 litre per room. If this figure is divided by two, as generally hotel rooms cater for two people, the average for South Africa, Namibia and Botswana is the highest of all the countries of which baselines are available.

Nine of the 10 highest water consuming lodges were located in Botswana. The three lowest water consuming lodges were all located in Namibia. The highest usage from all the lodges was lodge B13 with 4567 l/g/n. The lowest water consumption was at lodge N7 with only 485 l/g/n, which also was the best in class from the lodges presented in figure 28. The average water consumption from all 31 lodges across the three countries Figure 4.16 illustrates the water consumption per capita when staff nights were included. The results were presented as l/b/n.

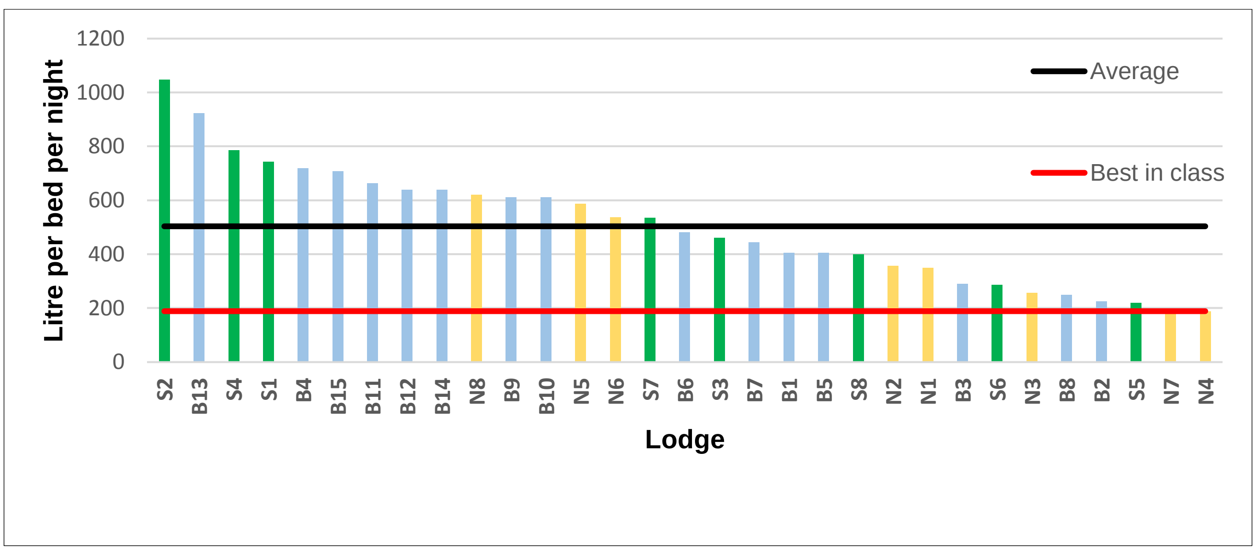

Figure 4.16: Litre per bed night from all the lodges in South Africa, Namibia and Botswana

Figure 4.16 indicates that the average water consumption per capita was 503 l/b/n when staff were included in the calculations. This average compares similar to 5 star hotels in Greece and Morocco and is less than hotels in Zanzibar, Thailand, Hong Kong and the Philippines. According to table 1, the 503 l/b/n compares very similar to hotels and lodges all across the globe. This means that when staff consumption is included in total consumption, the water usage is not as outrageously high as is suggested above when only guest consumption is used.

Three of the top five water consumers came from lodges located in South Africa. Six of the 10 highest water consumers came from lodges in Botswana. The two lodges with the lowest water consumption were both lodges situated in Namibia. The highest water usage was lodge S2 with 1048 l/b/n. The lowest water consumption per capita was lodge N4 with only 188 l/b/n, which was the best in class from all the lodges. The average consumption from all 31 lodges across all three countries was 503 l/b/n. Figure 4.17 illustrates the results from the eight lodges in South Africa with the regards to the international standard of l/g/n.

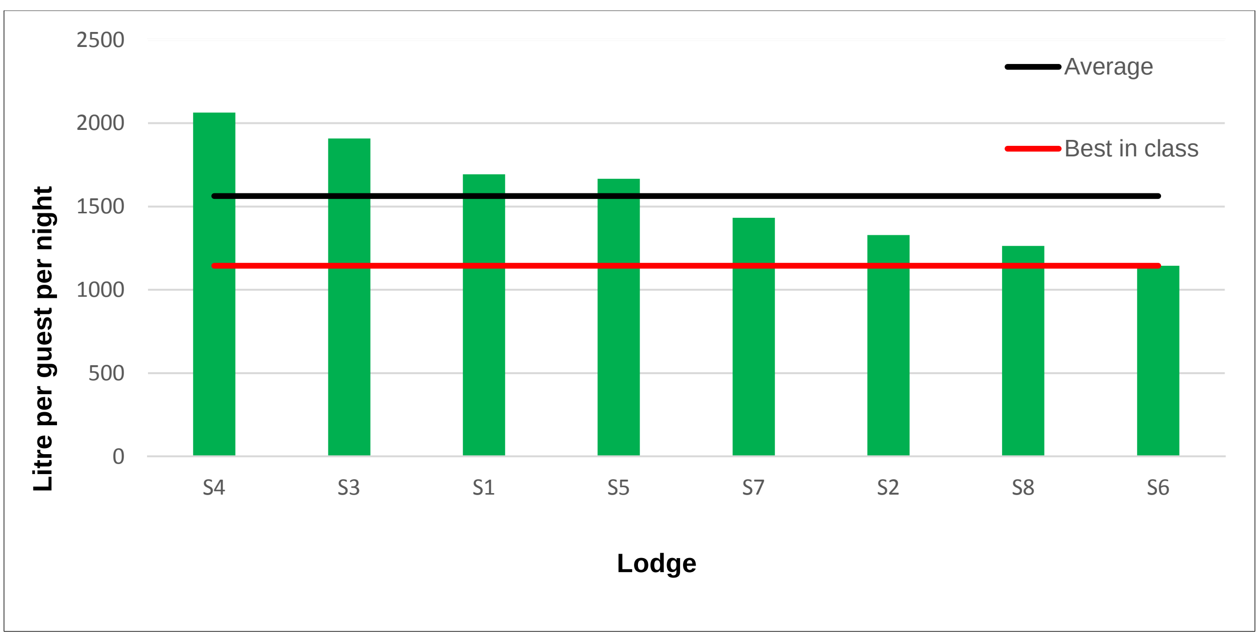

Figure 4.17: Litre per guest per night from the eight lodges in South Africa

Figure 4.17 indicates the same scenario as previously mentioned when only guest consumption is considered. The average of 1 562 l/g/n in South Africa is well above all the other countries listed in table 2.1, with the exception of Sharm El Sheikh, Hong Kong, Thailand and the Philippines. The results indicate that the lodge with the highest water consumption per capita was lodge S4 with 2063 l/g/n. The lodge with the lowest water consumption per capita was lodge S6 with 1144 l/g/n, also the best in class from all the lodges in South Africa. Figure 4.18 illustrate the results when staff was included in the calculations for South Africa.

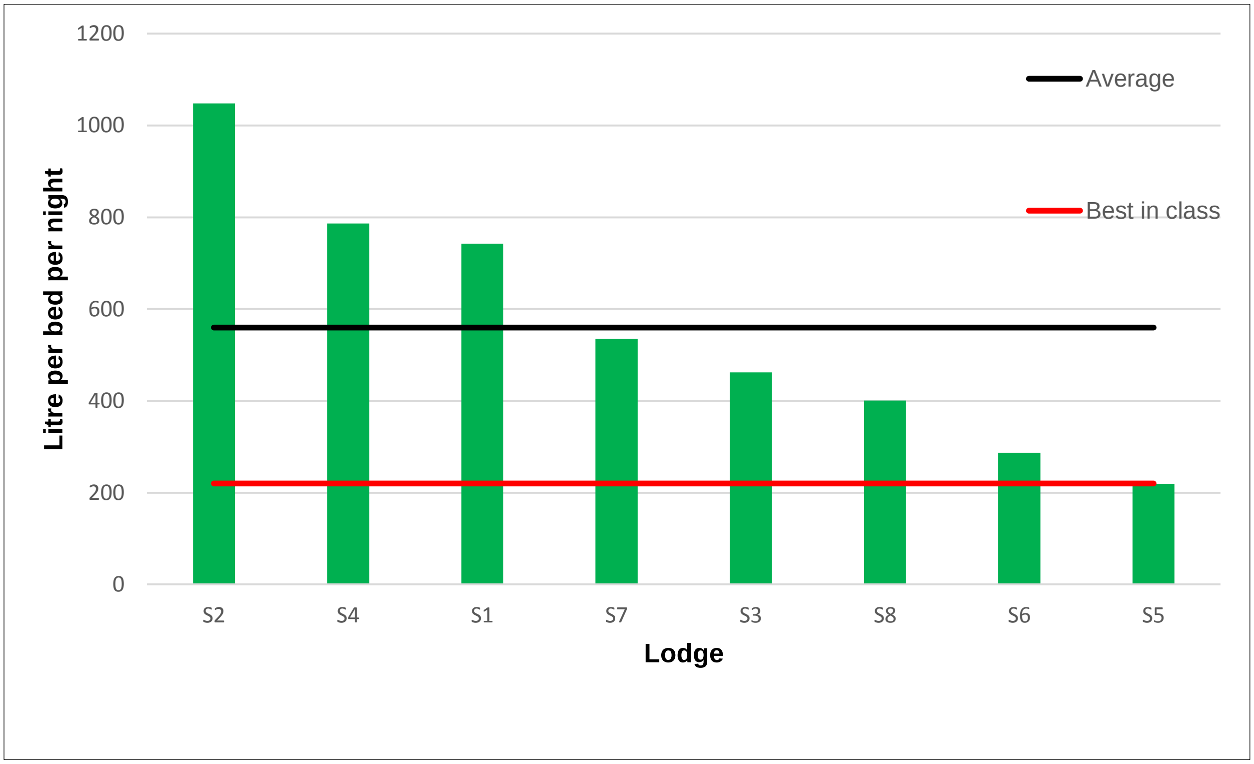

Figure 4.18: Litre per bed night from the eight lodges in South Africa

Figure 4.18 illustrates that the average water consumption per capita in South Africa of 560 l/b/n again compares similar to hotels and tourism establishments across the globe when staff is included in the calculations. The results indicate that the lodge with the highest water consumption per capita was lodge S2 with 1048 l/b/n. The lodge with the lowest water consumption per capita was lodge S5 with 220 l/b/n, also the best in class from all the lodges in South Africa. The main reason why the consumption at lodge S2 is considerably higher than the rest of the lodges in South Africa, is due to the fact that only small percentage of the staff reside on the property. Staff commuting from the local community to the lodge consumes water during their work shift, but because they are not staying on the property their consumption are not calculated into the bed nights. This is also the reason why lodge S2 have a very low staff to guest ratio which will be discussed later. Figure 4.19 illustrates the water consumption from the eight lodges in Namibia with the regards to international standard of l/g/n.

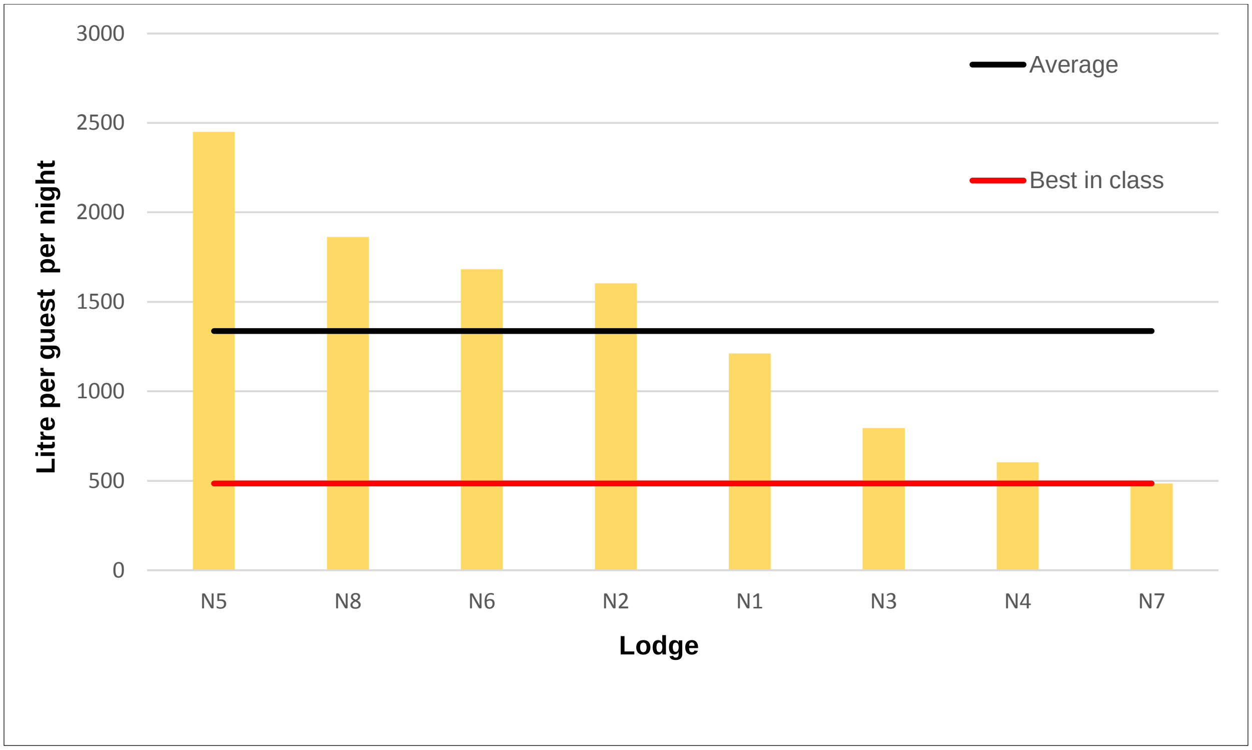

Figure 4.19: Litre per guest per night from the eight lodges in Namibia

Figure 32 illustrates the exact same findings as above. When only guest consumption is considered the average water consumption per capita in Namibia of 1 337 l/g/n is well above the baselines from hotels in other countries across the globe. The lodge with the highest water consumption per capita was lodge N5 with 2450 l/g/n. The lodge with the lowest water consumption per capita was lodge N7 with 485 l/g/n, also the best in class from all the lodges in Namibia.

Figure 4.20 illustrate the results when staff was included in the data analysis, as per recommendation by Mearns and Grobler (2016).

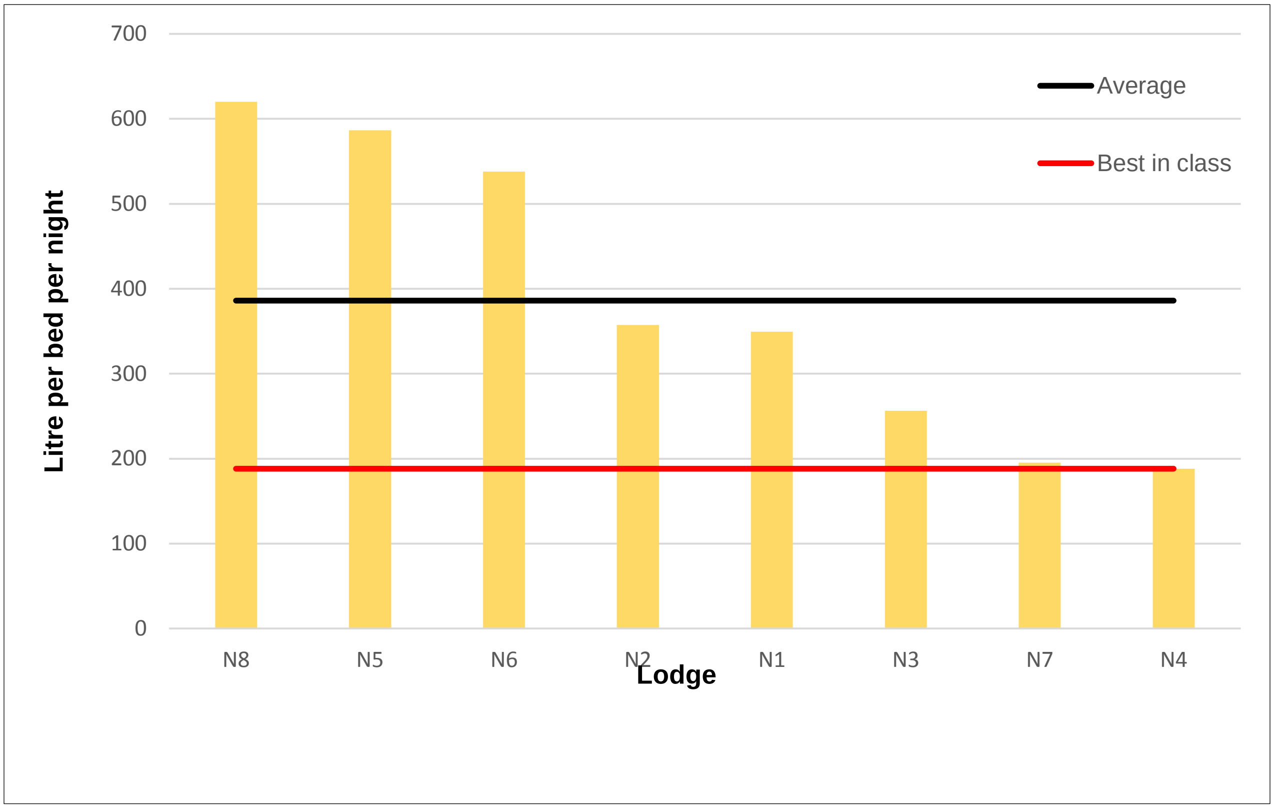

Figure 4.20: Litre per bed night from the eight lodges in Namibia

Figure 4.20 illustrates that the average water consumption per capita in Namibia of 386 l/b/n also compares similar to hotels and tourism establishments across the globe when staff is included in the calculations. The lodge with the highest water consumption per capita was lodge N8 with 620 l/b/n. The lodge with the lowest water consumption per capita was lodge N4 with 188 l/b/n, also the best in class from all the lodges in Namibia.

Figure 4.21 illustrates the water consumption from the 15 lodges in Botswana with the regards to international standard of l/g/n.

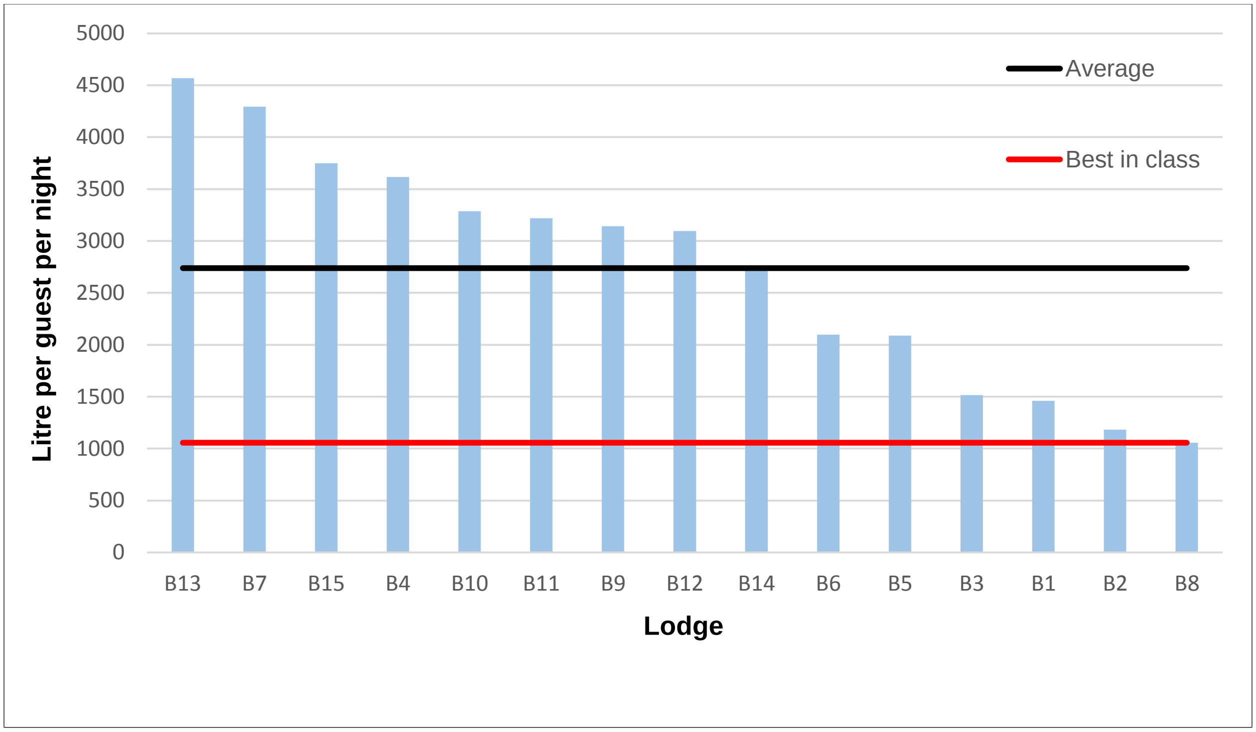

Figure 4.21: Litre per guest night from the 15 lodges in Botswana

Figure 4.21 illustrates the exact same result as the previous results from above. When only guest consumption is considered, the average water consumption per capita in Botswana of 2 739 l/g/n is well above the baselines from hotels in other countries across the globe. The results indicate that the lodge with the highest water consumption per capita was lodge B13 with 4567 l/g/n. The lodge with the lowest water consumption per capita was lodge B8 with 1055 l/g/n, also the best in class from all the lodges in Botswana. The average water consumption for lodges located in Botswana was 2739 l/g/n. Figure 4.22 illustrate the results when staff was included in the data analysis, as per recommendation by Mearns and Grobler (2016).

Figure 4.22 illustrates that the average water consumption per capita in Botswana of 534 l/b/n also compares similar to hotels and tourism establishments across the globe when staff is included in the calculations. The results indicate that the lodge with the highest water consumption per capita was lodge B13 with 923 l/b/n. The lodge with the lowest water consumption per capita was lodge B2 with 225 l/b/n, also the best in class from all the lodges in Botswana. The average water consumption with the inclusion of staff for all the lodges located in Botswana was 534 l/b/n.

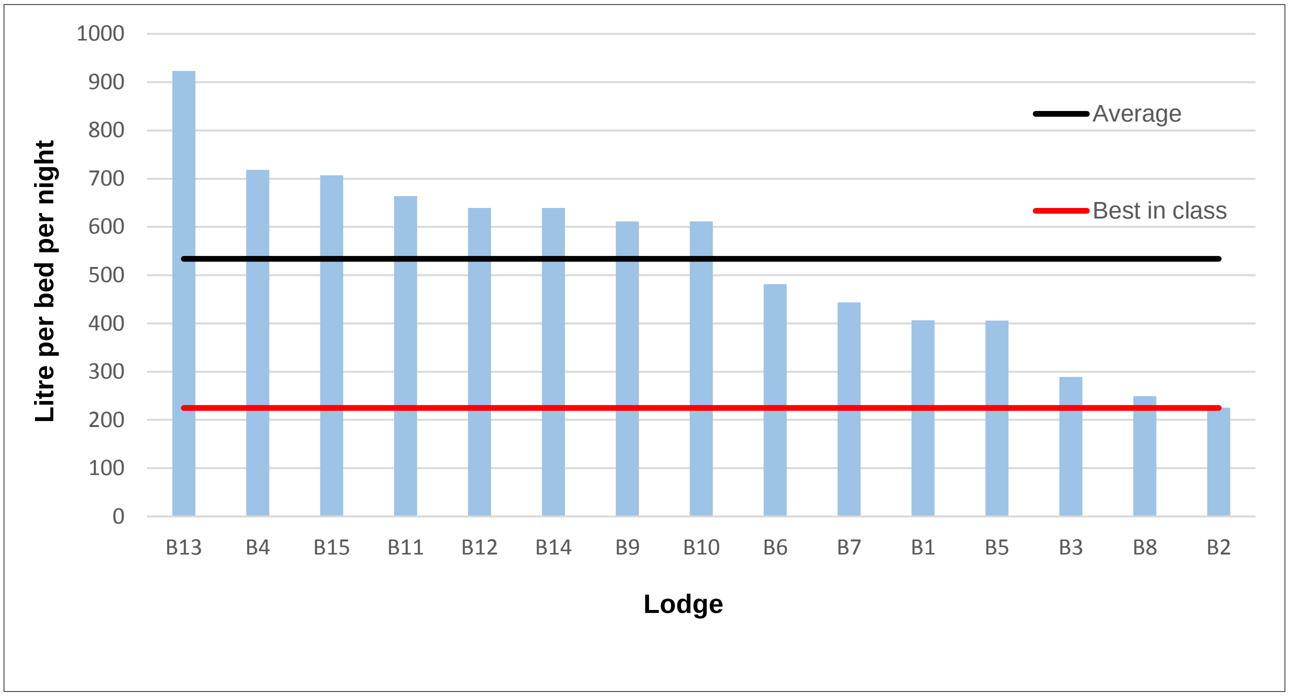

Figure 4.22: Litre per bed night from the 15 lodges in Botswana

The results clearly indicate that when only guest consumption is considered, the averages in all the calculations were outrageously high compared to countries such as Greece, Morocco, Zanzibar, Germany and the USA. When staff nights were included, the average water consumption was more or less similar to the majority of other countries around the world. The results indicate that the lodge with the highest consumption in Botswana, when only guests were considered, were more than double than the lodge with the highest consumption in South Africa and more than 2000 l/g/n more than the lodge with the highest consumption in Namibia. The lodges with the lowest consumption, when only guests were considered, were very similar in South Africa and Botswana but more than double than the lodge with the lowest consumption in Namibia. The average consumption in South Africa and Namibia, when only guests were considered, were similar with averages of 1562 l/g/n and 1337 l/g/n irrespectively with the lodges in Botswana averaging more than double than the lodges in Namibia with an average of 2739 l/g/n.

The results indicate that the lodge with the highest consumption in South Africa, when guests and staff were considered, were similar to the lodge with the highest consumption in Botswana. The Namibian lodge with the highest consumption were 300 l/b/n less than the lodge with the highest consumption in Botswana. The lodges with the lowest consumption, when guests and staff were considered, were very similar in all three countries, ranging from 188 l/b/n to 225 l/g/n. The average consumption in South Africa and Botswana, when only guests were considered, were similar with averages of 560 l/b/n and 534 l/b/n irrespectively. The lodges in Namibia had the lowest average of all three countries averaging only 386 l/b/n.

Table 4.7: Water consumption summary

	All 3 countries	**South Africa**	**Namibia**	**Botswana**
Highest consumption, guests only (l/g/n)	4567	2063	2450	4567
Lowest consumption, guests only (l/g/n)	485	1144	485	1055
Average, guests only (l/g/n)	2073	1562	1337	2739
Highest consumption, guests and staff (l/b/n)	1048	1048	620	923
Lowest consumption, guests and staff (l/b/n)	188	220	188	225
Average, guests and staff (l/b/n)	503	560	386	534

The author used two statistical analyses tools to indicate the differences between the three countries. The first tool was a boxplot to indicate the median and different ranges of water consumption in the three countries. The results are illustrated in figure 4.23.

The boxplot analyses indicate that when the l/g/n figures were considered, Botswana had the highest consumption, median and range of all three countries. Namibia also had a slightly bigger range than South Africa however the median for these two countries were very similar.

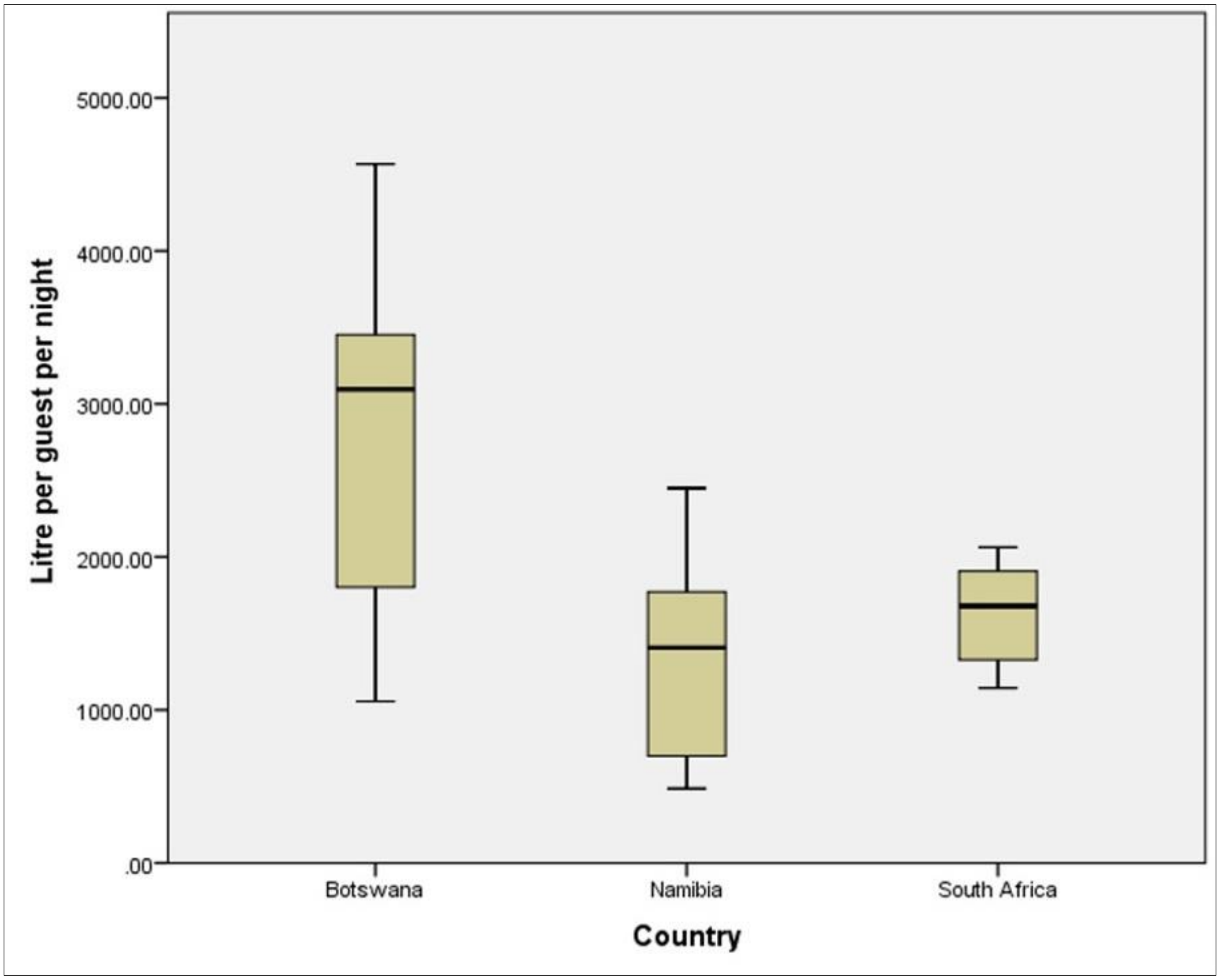

Figure 4.23: Boxplot analyses of water consumption from South Africa, Namibia and Botswana

The second statistical tool the author used was a Tukey HSD (honest significance difference test) from the analyses of variances (ANOVA). The results from the Tukey HSD are tabled in table 4.8. The purpose of this analyses was to determine the difference per capita between the three countries.

The table indicates that lodges in Botswana use 1402 l/g/n more than Namibia and 1105 l/g/n more than South Africa. Namibia uses 296 l/g/n less than South Africa. From both analyses it is clear that water consumption in Botswana are significantly higher per capita than in South Africa and Namibia.

Table 4.8: Tukey HSD analyses of the l/g/n from South Africa, Namibia and Botswana

Dependent Variable: Guests Only L/G/N

Tukey HSD

(I) Country	(J) Country	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Botswana	Namibia	1402.1304*	397.80685	.004	413.6227	2390.6382
	South Africa	1105.4493*	438.92200	.047	14.7748	2196.1239
Namibia	Botswana	-1402.1304*	397.80685	.004	-2390.6382	-413.6227
	South Africa	-296.6811	490.72972	.819	-1516.0924	922.7301
South Africa	Botswana	-1105.4493*	438.92200	.047	-2196.1239	-14.7748
	Namibia	296.6811	490.72972	.819	-922.7301	1516.0924

Based on observed means.

The error term is Mean Square (Error) = 825653.679.

*. The mean difference is significant at the 0.05 level.

Three factors that could severely impact on water consumption were identified by the author in the analyses. The first factor that the author considered was whether seasons play a role, especially due to hot to extremely hot summers in all of the regions. Only the lodges from Namibia and Botswana that had full sets of data were considered in this part of the analyses. The South African lodges were excluded since only two lodges had complete sets of data. In both Namibia and Botswana, the months that was used for summer were October to March and April to September was used for the winter months.

Figure 4.24 illustrate the summer against winter consumption in Namibia.

The results indicate that the l/g/n consumption were more in winter than in summer only at lodge N1 and N2. All the other lodges used slightly more water in summer than in winter. The average l/g/n consumption across all the lodges in Namibia for summer was 1235 l/g/n and 1294 l/g/n in winter. The results indicate that overall the lodges in Namibia use 4.8% more water in winter than in summer.

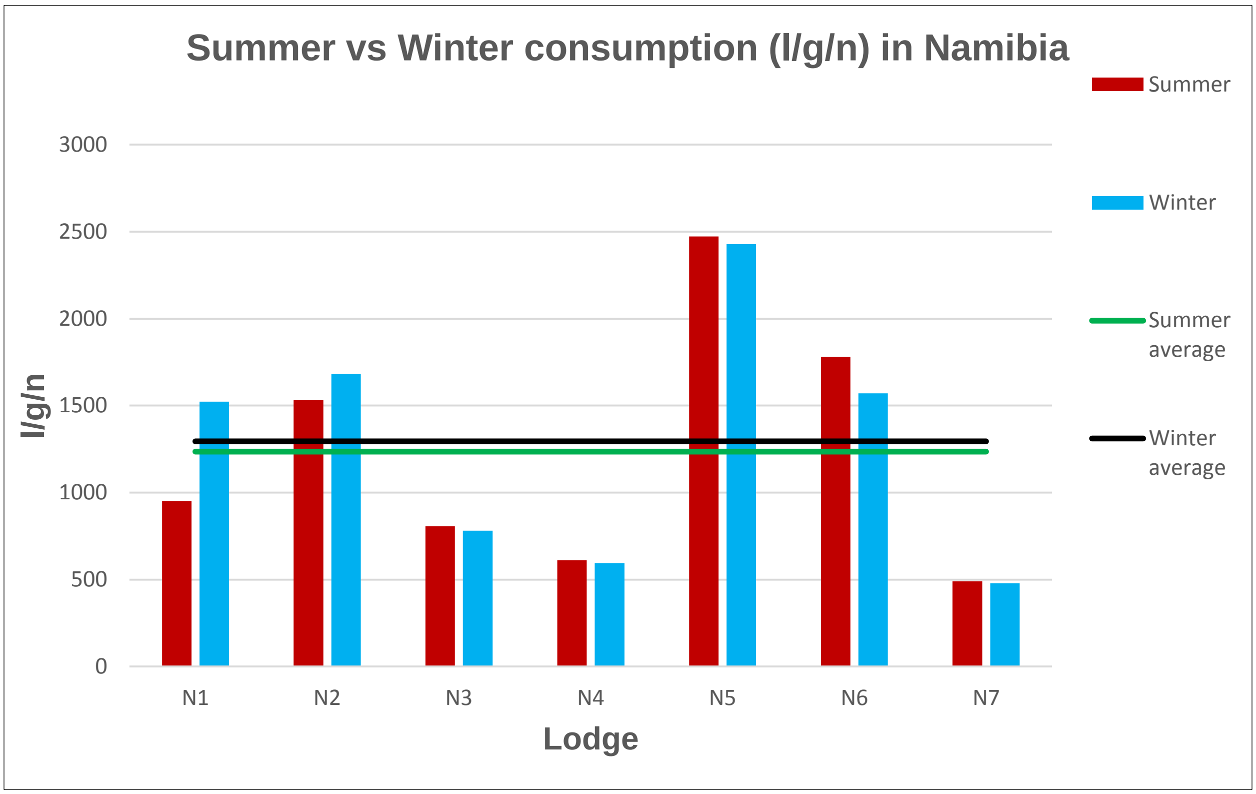

Figure 4.24: Summer vs winter consumption in Namibia

Figure 4.25 illustrate the summer against winter consumption in Botswana

In contrast with Namibia, the results indicate that the l/g/n consumption were more in summer than in winter. With exception of lodge B1, all the other lodges had a higher l/g/n consumption rate. The average across all the lodges in Botswana was 2698 l/g/n in summer and 2231 l/g/n during winter. The results indicate that overall lodges in Botswana use 17.3% more water in summer than in winter. Due to difference in percentages, it is evident that seasons and climate play a much more prominent role in water consumption in Botswana than in Namibia. Factors that could add to the higher consumption in Botswana in summer could be more evaporation of water from pools, greater desire from staff and guests with regards to hygiene and cleanliness, taking refreshing showers to cool down, summer is also the rain season and vehicles might get dirtier due to driving through mud, requiring more regular washing than in winter. Although only speculation though, to establish the exact reasons more investigation is required.

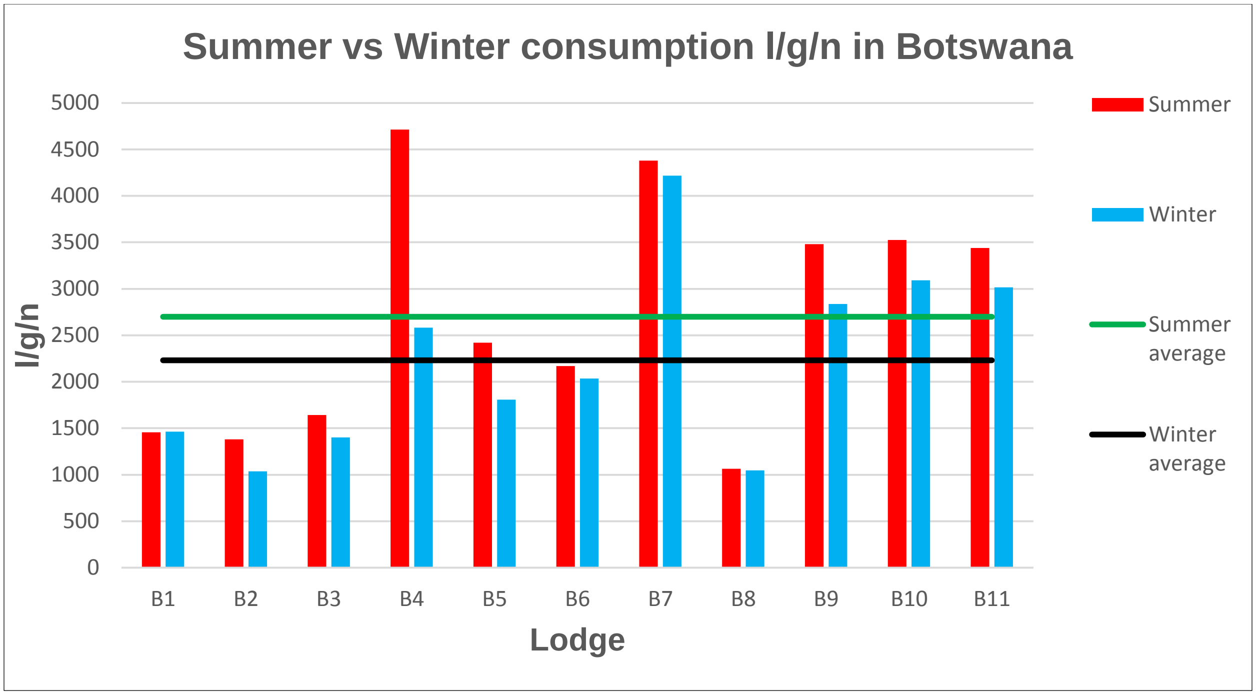

Figure 4.25: Summer vs winter consumption in Botswana

The second factor that the author considered was level of service. The author identified three components that can be directly linked to level of service. The first component was the guest to staff ratio as more staff generally increase level of service. The second component the author identified was the rate per person per night in US $. A higher rate usually mean more luxury and exclusivity. The final component the author identified is the number of swimming pools at each lodge. Some lodges offer private pools whereas others offer a shared pool or pools. To establish if the level of service has an impact on water consumption, the author used correlation coefficients to determine if there is a correlation between the three components and water consumption at the lodges. Table 4.9 state the results from the statistical analysis.

Table 4.9: Correlation coefficients for level of service components

		Guests Only l/g/n	Guests And Staff l/b/n
Guest :Staff Ratio	Pearson Correlation	0.569**	-0.209
	Sig. (2-tailed)	0.001	0.276
	N	29	29
Rate US$	Pearson Correlation	0.648**	0.162
	Sig. (2-tailed)	0.000	0.400
	N	29	29
No Of Pools	Pearson Correlation	0.429*	0.314
	Sig. (2-tailed)	0.020	0.097
	N	29	29

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The results indicate that there is a strong correlation between the guest to staff ratio and water consumption when only guest nights were considered. The R-value of 0.569 is significant with an accuracy level of 0.01 (99%). The rate in US $ had the strongest correlation with an R-value of 0.648, also indicating a significant correlation at a 0.01 level. The number of pools had a poor correlation with an R-value of 0.429 at a level of 0.05 (95%) accuracy, suggesting that the number of pools does not have a big impact on water consumption. Based on the strong correlations between the rate in US $, guest to staff ratio and water consumption, the author were able to formulate forecasting formulas. These forecasting formulas are illustrated in figure 4.26 and figure 4.27.

The statistical analysis strongly suggests that the level of service do add to water consumption per capita when only the l/g/n consumption was considered. A weak correlation was established between the guest to staff ratio and water consumption per capita as l/b/n. The R-value of -0.209 is insignificant with a accuracy level of 0.276 (evidence is random). The same applied for rate in US $ with an R-value of 0.162, also indicating an insignificant correlation at an accuracy level of 0.4. The number of pools had a poor correlation with an R-value of 0.429 at a level of 0.05

The forecasting formula of 1.6667 * x +0 can be used by replacing the x value with the US $ rate. A lodge with a rate of 1900 US $ per person per night can therefor forecast their monthly consumption by applying the formula, 1.6667 * 1900 +0 = 3167 l/g/n. The guest nights from confirmed bookings can then be used for example 380 guest nights * 3167 = 1, 203 kilolitre predicted water consumption for the month.

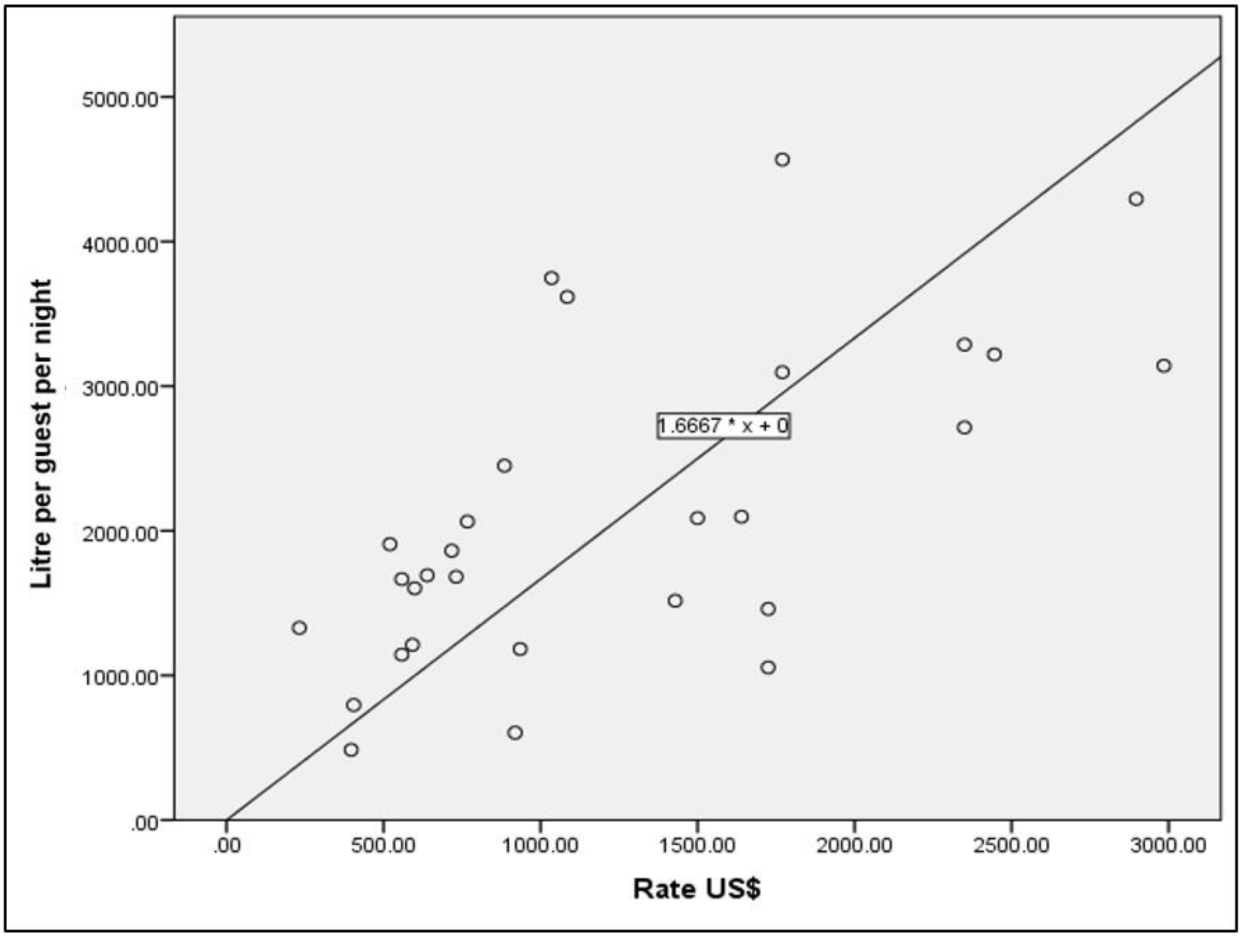

Figure 4.26: Correlation coefficient and forecasting formula for rate in US $

The guest to staff ratio will play an important role in the forecasting as well. Since the staff residing at the lodge are fairly constant, the guest to staff ratio can also be determined from confirmed bookings. If the staff nights predicted for the same lodge as above are 2300 and the guest nights are 380, the guest to staff ratio will be 1:6. This will trigger the formula: 500 * x +0, which will be 500 * 6 +0 = 3000 l/g/n. The guest nights can then be applied to the l/g/n which will be 3000 * 380 = 1 140 kilolitre predicted water consumption for the month. The two values can then provide a ballpark forecasting figure by estimating the range of water consumption to be between 1140 kilolitre and 1203 kiloliter for the month or a single prediction figure can be established by adding the two values and dividing them by two for example (1140+1203) / 2 = 1 171 kilolitre prediction for the month.

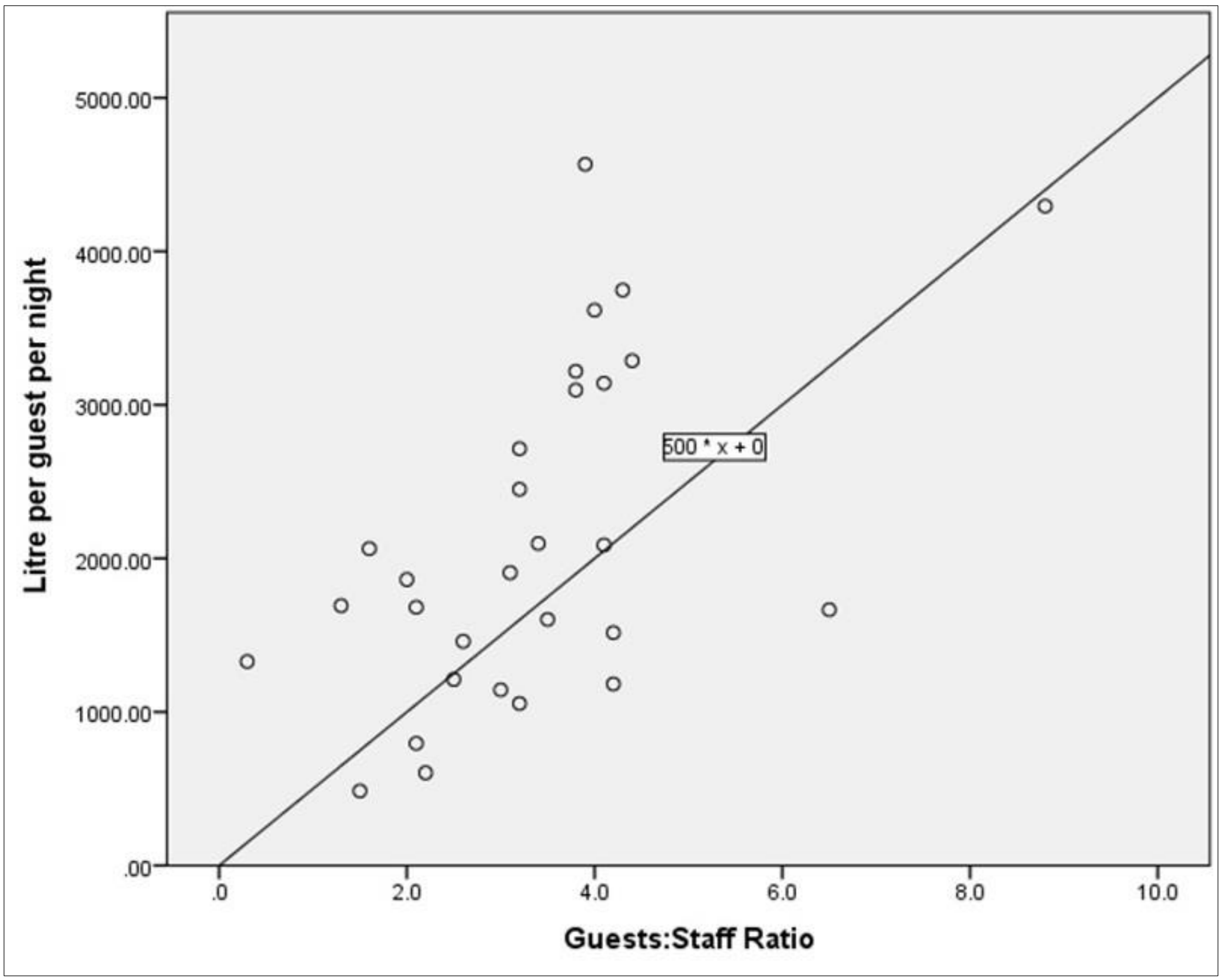

Figure 4.27: Correlation coefficient and forecasting formula for guest to staff ratio

The author also used the boxplot analyses and Tukey HSD analyses to determine the difference in rate from the three countries. The boxplot analyses is illustrated in figure 4.28 and the Tukey HSD in table 4.10.

The boxplot analyses indicate that Botswana have a much higher range and median with regards to rate in US $ compared to South Africa and Namibia, who again seem to have a similar range with a slight difference in median. The Tukey HSD analyses indicate that the median rate in US $ in Botswana is 1187 US $ more than in Namibia and 1297 US $ more than in South Africa. The median rate in US $ in Namibia was 109 US $ more than in South Africa.

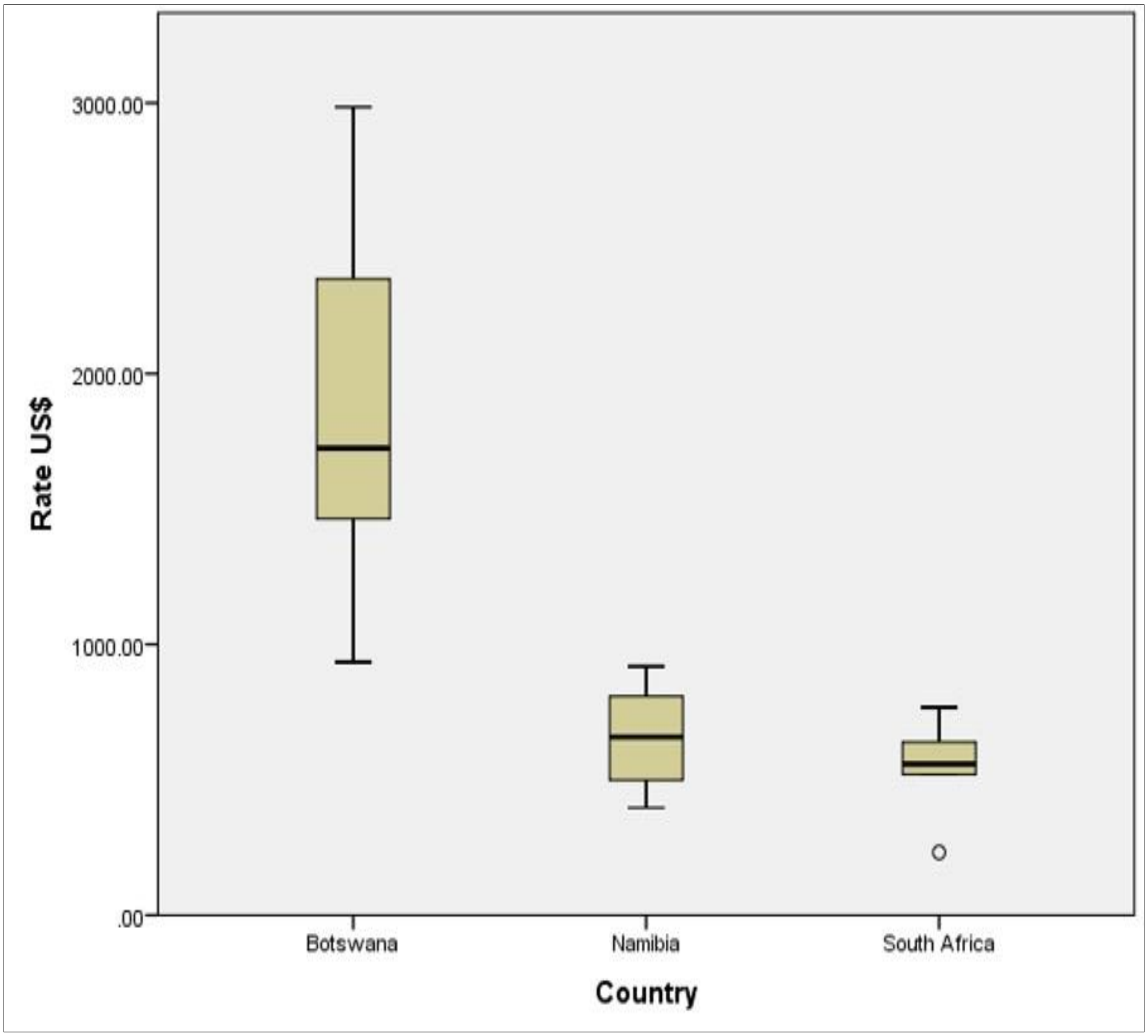

Figure 4.28: Boxplot analyses of rate in US $ in South Africa, Namibia and Botswana

Table 4.10: Tukey HAD analyses for rate in US $ in South Africa, Namibia and Botswana

Dependent Variable: Rate US$						
Tukey HSD						
					95% Confidence Interval	
(I) Country	(J) Country	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Botswana	Namibia	1187.1083*	212.71013	.000	658.5462	1715.6704
	South Africa	1297.0667*	234.69470	.000	713.8753	1880.2581
Namibia	Botswana	-1187.1083*	212.71013	.000	-1715.6704	-658.5462
	South Africa	109.9583	262.39665	.908	-542.0695	761.9861
South Africa	Botswana	-1297.0667*	234.69470	.000	-1880.2581	-713.8753
	Namibia	-109.9583	262.39665	.908	-761.9861	542.0695

*. The mean difference is significant at the 0.05 level.

The third factor that the author considered was to determine the staff's share of the water consumed at the lodges. To establish a calculated estimate, the author used l/b/n figure from each lodge individually and calculated the figure with the amount of staff nights of the corresponding lodge. To establish an average l/b/n figure for each lodge, the author used the total water consumption over the 24 month period and divided it by the sum of the total guest nights and total staff nights over the same period. The equation that was used was thus:

l/b/n =Total water consumption / (total guest nights + total staff nights)

The three countries were examined individually as well as all the countries together.

Figure 4.29 illustrate the calculated percentages as well as the average of water consumed by staff against guests for South Africa.

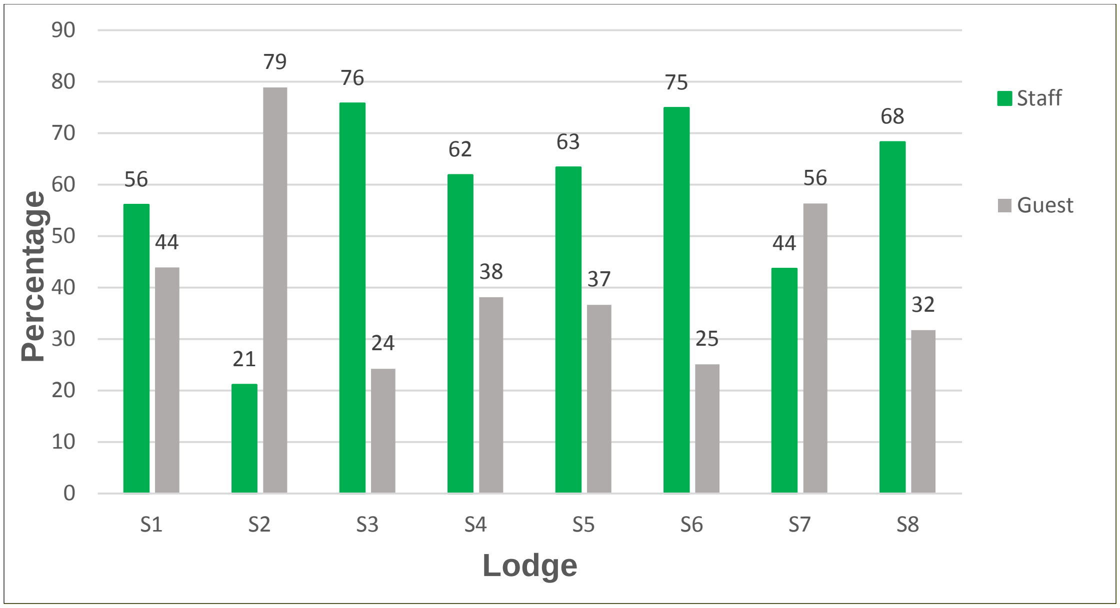

Figure 4.29: Staff against guest percentage of consumption in South Africa

With the exception of Lodge S2 and S7, staff were responsible for between 56% and 76% of the total water consumption at the lodges in South Africa. The average for the lodges in South Africa showed that staff were responsible for 58% of the total consumption against the 42% due to guests. The results are based on the assumption that guests and staff use the same volume of water per night.

Figure 4.30 show the results for Namibia.

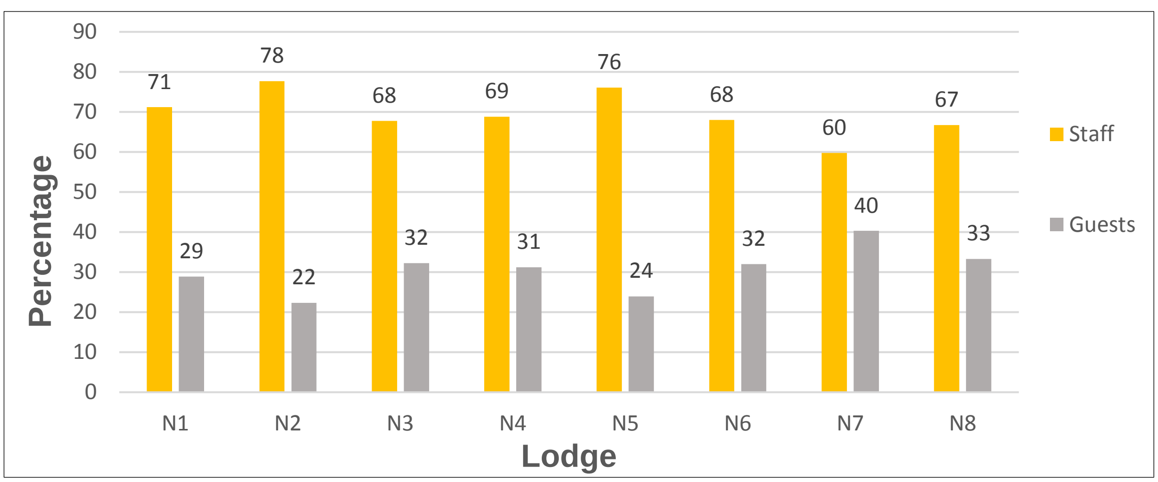

Figure 4.30: Staff against guest percentage of consumption in Namibia

The results indicate that staff were responsible for between 60% and 78% of the total water consumption at the lodges in Namibia. The average consumption by staff for the lodges in Namibia were 69% against the 31% due to guests. The results are based on the assumption that guests and staff use the same volume of water per night.

Figure 4.31 indicate the results for Botswana whereas figure 4.32 illustrate the staff consumption of all three countries together as well as the average staff contribution and average guest contribution of all three combined.

Figure 4.31 illustrate the staff were responsible for between 72% and 90% of the total water consumption at the lodges in Botswana. The average consumption for staff at all the lodges were 80% against the 20% of guests. The results are based on the assumption that guests and staff use the same volume of water per night.

Figure 4.32 illustrate that across all three countries the average staff contribution was 72% of the total water consumption. Only 28% of the water consumed at the lodges were consumed by the guests. Botswana had the highest staff contribution with an average of 80% across all the lodges. Namibia had the second highest staff contribution with an average of 69% whereas South Africa had the lowest staff contribution with an average of 58%. The results are based on the assumption that guests and staff use the same volume of water per night.

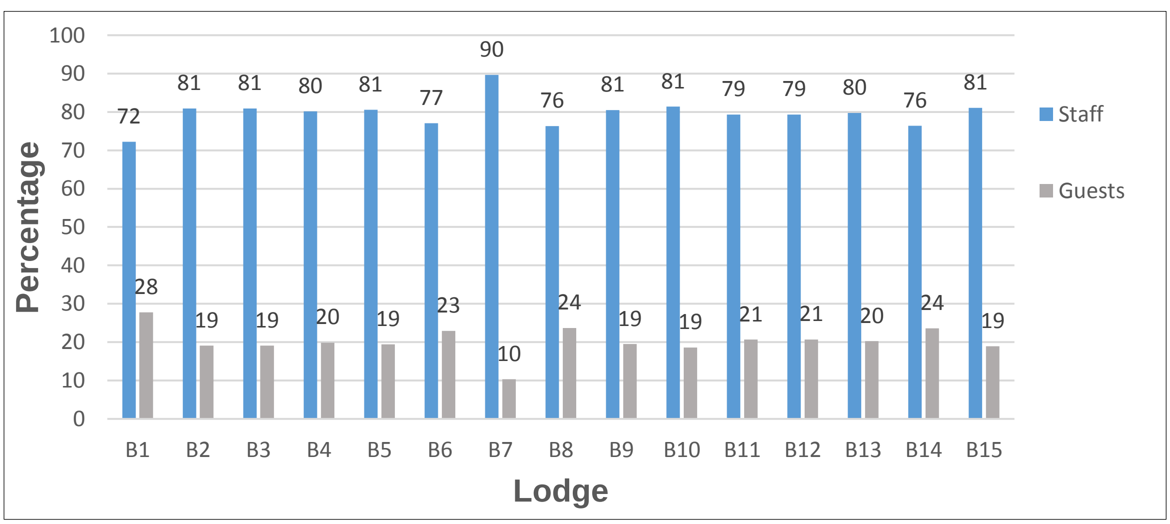

Figure 4.31: Staff against guest percentage of consumption in Botswana

Since the number of staff at the lodges are fairly constant throughout the year, these high percentages can explain why the consumption at the lodges in Botswana is higher during the summer than in winter. The evidence thus suggests that staff use more water during summer than in winter in Botswana. The figures also support the anomalies in the level of service (staff to guest ratio) as the consumption per capita is more reliant on staff consumption rather than guest consumption, meaning that a lodge with a low level of service can have a higher consumption per capita than a lodge with a higher level of service, and vice versa, due to the high percentage and impact of staff consumption. It is also possible that geological location might have a big impact on staffs' perception and consumption as the figures suggests. In the Okavango Delta where surface water is abundant and available throughout the year, it is possible that staff might be less diligent to use water more sparingly than staff in the drier regions of Namibia and South Africa, where water is mainly seasonal or from groundwater supply. Although this cannot be proven in this study, the theory does require further investigation.

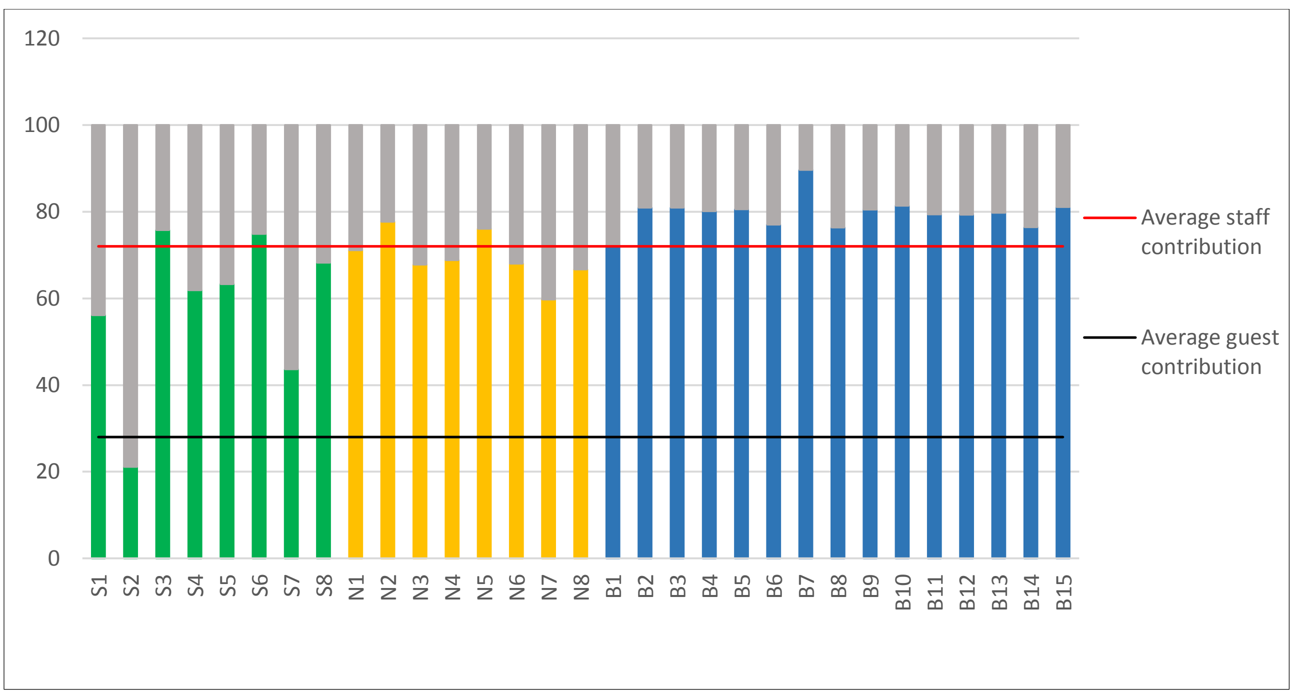

Figure 4.32: Average staff and guest contribution of all three countries

4.5.3 Summary of water quantity baselines and benchmarks

The average water consumption per capita across all three countries were 2073 l/g/n and / or 503 l/b/n. Botswana had the highest per capita when only guest consumption were considered with an average of 2739 l/g/n against the 1562 l/g/n of South Africa and the 1337 l/g/n in Namibia. South Africa had the highest average when both staff and guest nights were considered with an average of 506 l/b/n against the 534 l/b/n of Botswana and the 386 l/b/n of Namibia. The Tukey HSD analyses indicated that when only guest consumption was considered, lodges in Botswana consumed 1402 l/g/n more than the lodges in Namibia and 1105 l/g/n more than lodges in South Africa. Lodges in Namibia consumed 296 l/g/n less than the lodges in South Africa.

The author identified three factors that could impact on water consumption. The first factor indicated that seasons play a much more prominent role with regards to water consumption at the lodges in Botswana than in Namibia. The level of service was divided into three components, rate in US $, staff to guest ratio and number of swimming pools at each lodge. Strong correlations between the rate in US $ and the staff to guest ratio could be established, however only when guest only (l/g/n) consumption was considered. Weak correlations were established when both staff and guest (l/b/n) consumption was considered. The Tukey HSD analyses indicated that the lodges in Botswana have a higher median rate in US $ than lodges in South Africa and Namibia. The median rate in Botswana was 1187 US $ more than the median rate in Namibia and 1297 US $ more than the median rate in South Africa. The median rate in Namibia was 109 US $ more than the median rate in South Africa. No correlation between the number of pools and water consumption could be established.

The last factor that the author considered was to determine how much of the total consumption is due to staff. The author concluded that in South Africa staff is responsible for 58% of the total water consumed, whereas in Namibia staff consumes 69% of the total volume and 80% in Botswana. The average staff contribution across all three countries were 72%.

4.6 Other management components

4.6.1 Introduction

In this section of the chapter the author considered other factors that play an important role in a water management system. The three major factors identified by the author were stakeholder involvement, financial implications and monitoring measures of the water management system or program. To obtain the information in this section the author conducted interviews with key personnel from the two organisations.

4.6.2 Results, discussion and analyses

4.6.2.1 Stakeholder involvement

Government involvement

Government involvement in all three countries are very limited in terms of regulating water quantity and quality. When a water use such as well point or borehole is registered or permitted, there is very little to no control from government to monitor or regulate the water quantity and quality. Organisations also do not pay per litre as one would do when obtaining water from a municipal supply. Although all three countries have standards and requirements with regards to drinking water and wastewater quality, there is no legal obligation to implement these analysis at the lodges. The only legislation in South Africa that can be applicable with regards to water quality is Section 8 of the Occupational Health and Safety Act (OHSA) which states: "*Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees*". Although this does to a certain extent force the employer to ensure water is safe for domestic purposes, it does specify what would reasonably practicable for instance annual testing, bi-annual or monthly. As mentioned in chapter 2, as water pollution increase and good freshwater quality decrease, governments might enforce stricter measures in the near future, which would have a cost implication for the wildlife lodge industry.

Staff involvement

Both organisations have an environmental plan or guidelines to ensure that staff and management at the camps implement good practices. Wilderness Safaris has the GEMS

(Group Environmental Minimal Standards) whereas &Beyond has a BOP (Best Operational Practices). All staff undergo training about the organisations environmental requirements before camps are operational, and when new staff are employed. Comments from a staff member is that staff must use wastewater from reverse osmosis (RO) systems to wash vehicles. The author noted that this does not happen at the camps and that the wastewater from these systems are discharged into the environment. Considering the locations of the RO systems and the location of the wash bays, it is not possible to utilise the water from the RO system at the wash bay due to the distance between them. To utilise the wastewater from the RO system in the wash bay the water will need to be stored in a tank and pumped to the wash bay approximately 150 meters away. This operation will not be feasible. Another comment was that staff must use a bucket to catch water from showers while they are waiting for the hot water to get hold and use this water in the laundry or for housekeeping. Although the author cannot confirm that this occurred, the distance from the staff quarters to the laundry might discourage staff to do this. Neither organisations had a schedule or plan to create awareness throughout the year for staff. Staff only undergo training on employment. The nature of the business makes it very difficult to provide formal awareness due to the fact that there is always staff on leave and that lodge operations must continue. The results indicated the impact that staff have on water consumption and this confirmed by a staff member at one of the camps who stated that during the summer months, it is common for him to have up to four showers a day. A common observation in the results at all the lodges were when guest numbers decreased, water consumption increased. This was also noted at one camp when there were zero guests for the month, the water consumption was nearly double than it was three months prior with more than 300 guest nights.

The fact is that staff live on premises consume water for all their domestic needs (food, washing etc.), according to the results 72% of the total consumption across the three countries. It is of utmost importance that organisations involve staff in water saving measures, create awareness and even implement water saving devices and strategies in the staff quarters as well as in the guest rooms.

Guest involvement

Both organisations involves guests in their water management systems by creating awareness such as information leaflets in rooms and offering guests back-of-house tours to illustrate to them the water processes and intention to use water sustainably. The most common features in guest rooms are installations such as low pressure shower heads, dual flush toilets and aerated taps, although not all the lodges are fitted with these water saving devices. Guests are also encouraged to limit their laundry requirements. Guests who stay at camps for longer periods are encouraged to do their laundry all at once instead of two or three items every day. Another strategy the lodges implement is to advise guests to hang up their towels if they want to use it again, or leave it on the ground if they want it washed. The success of these strategies and communications were not investigated in this study and requires further investigation with regards to guest attitude towards saving water and their cooperation.

Local community involvement

The lodges in Namibia and Botswana are in extremely remote locations and do not have local communities in the surrounding areas. Only one reserve in South Africa have local communities in its surroundings. These communities are not involved in any programs or strategies implemented by the reserve.

4.6.2.2 Financial implications

Only three from the 31 lodges in this study is connected to a municipal pipeline. All the other lodges source their water from a natural resource such as a river, well point or a borehole. This results that for the majority of the lodges, there is no real cost related to the volume of water that is consumed as would be the case when connected to a municipal service. These lodges do not pay for water. There is thus no financial benefit to lodges to save water or use water more sparingly. Any water saving device or feature is thus an expense that will have no financial benefit to the company. This justifies the idea of not replacing plumbing and systems to recycle water at the lodges as the cost to change the existing infrastructure will be huge with no return on their investment. Recycling systems will only be feasible when new lodges are built and it is incorporated in the design from the beginning. The same principle will apply with rainwater harvesting. The only part where the organisations can financially benefit is with regards to quality. Although an UV light system will consume energy, the cost and transport of chemicals such as chlorine can be measured and an informed decision can be made with regards to costs and benefits. Automated systems will also release man power and could save an organisation money on labour. An UV light system will also reduce the risk of lodges running out of chlorine and will eliminate transport and stock from supplier challenges. Other forms of water treatment such as RO systems may be more effective than older technologies, and a cost-benefit analysis should be done to determine the feasibility of new technologies.

4.6.2.3 Monitoring of systems

Both organisations make use of annual or bi-annual audits to monitor their environmental standards, including their water management system. Lodge managers have monthly checklists to complete and during droughts at certain camps, water management systems were checked daily. The standards and guidelines of the organisations are general standards and not all the requirements in the standards are applicable to all the camps. This is evident in the camps where the RO systems are 150m away from the wash bay, but the standard would require them to re-use the RO wastewater to wash vehicles. This would be a non-compliance against the standard but an impractical operation. After the audits, the management systems and guidelines are updated every year.

4.6.3 Summary of other management components

Involvement from stakeholders such as national and local governments, staff, local communities and guests are very limited. Government’s involvement after the registration of a permissible water use is non-existent. No regulation with regards to water quantity and quality are implemented or enforced apart from the water quality guidelines and standards, which is optional and not a requirement. Staff are also trained upon employment and no program or training schedule is used to encourage staff continuously to save water or create awareness. Considering the high percentage of staff usage, it is highly recommended that programs and initiatives are implemented for staff. Due to the remote locations of many of the lodges, local communities at the majority of the lodges are absent. Few initiatives to involve guests to save water are implemented at all the lodges and awareness are created through leaflets in rooms.

Since 28 out of the 31 lodges source their water from natural sources rather than a municipal supply, there is very little cost involved with regards to the amount of water a lodge consumes. This results in that there is no financial benefit to implement water conservation measures apart from avoiding the risk of depleting the source, which could lead to the ceasing of operations of a lodge. All the lodges have a systems monitoring procedure in the form of annual and bi-annual audits. Lodge managers also have monthly checklists to complete to ensure the monitoring of their water management system.

Although governments are not involved in water management at the operational phase of the lodges, it is highly recommended that the lodges do water quality tests to ensure the health and safety of staff and guests, and to ensure that the wastewater discharge is not detrimental to the environment. Depleting water sources could lead to the ceasing of lodge operations and it is highly recommended that the lodges continue or start measuring water quantity. It is also recommended that more training and awareness presentations are delivered to staff to ensure water is not wasted.

5. Synthesis, recommendations, study contribution, limitations of study and conclusion

5.1 Introduction

In this final chapter the author synthesised the results against the study objectives, made recommendations based on the findings and analyses of the results, and concluded the study by providing a summary of the study.

5.2 Synthesis

The first objective of the study was to determine the frequency and significance of water quality testing at lodges in South Africa, Namibia and Botswana. The results indicated that 50 % of the lodges in South Africa tested water quality at the source, 88% tested water quality from a tap and 75% tested the wastewater discharge. Although the percentages are high for tap water analyses, only 25% of the lodges had tested more than 26% of the required parameters to be tested as stated in the SANS 241: 2015 drinking water standard, making the tests incomplete and insignificant. In Namibia none of the lodges had done tests on the source or wastewater discharge, however, 75% of the lodges had water quality tests done on their tap water. As in South Africa, only 37% of the parameters as stated in the standard was tested with no microbiological tests done at any of the camps. Another observation was that the results from 50% of the lodges were exactly the same for all the parameters either two or three years in a row, creating a strong impression that the supplier copied and pasted the results from the first analyses. It was therefore concluded that water quality results in Namibia were also insignificant and unreliable. Lodges in Botswana had the biggest challenge with regards to water quality testing as only 33% had test on their source and tap water, and none on their wastewater discharge. Only 28% of the required parameters as stated in the BOS 32:2009 was tested during the water quality analyses. The water quality analyses are also done by students at the university in Maun rather qualified scientists, also resulting in the water quality results being unreliable and insignificant.

The second objective of the study was to determine the frequency and accuracy of water quantity measurements. The results indicated that 25% of the lodges in South Africa had complete sets of data, 25% had 1-2 months of missing data whereas 50% had 3 or more months of missing data. This indicated that the majority of the lodges did not measure water as per organisations' requirements. In Namibia 88% of lodges had complete sets of data whereas 73% of the lodges had complete sets of data in Botswana. The accuracy was however impacted at some lodges as water meters were installed at the incorrect positions and faulty equipment lead to overflows at storage units.

The third objective of the study was to determine if the water quality from the results comply with the limits as stated in the relevant country's standards. Several lodges had issues with Iron, Sulphate and Chloride levels. Although *E. coli* were absent at all the lodges, two lodges had small amounts of coliform bacteria in their water.

The fourth objective of the study was to develop water quantity baselines and benchmarks for the industry as a whole across all three countries and each country individually. The baseline water consumption for all three countries as a whole was 2073 l/g/n or 503 l/b/n. The best in class method was used as the benchmark, which was 485 l/g/n or 188 l/b/n. The water consumption baseline in South Africa was 1562 l/g/n or 560 l/b/n. The benchmark of the best in class was 1144 l/g/n or 220 l/b/n. In Namibia the baseline water consumption was 1337 l/g/n or 386 l/b/n. The best in class benchmark was 486 l/g/n or 188 l/b/n. In Botswana the water consumption baseline was 2739 l/g/n or 534 l/b/n. The best in class benchmark was 1055 l/g/n or 225 l/b/n.

The fifth and final objective of the study was to investigate other management components with specific regards to stakeholder involvement, financial implications and monitoring systems. The results indicated very little stakeholder involvement with regards to governments, staff, guests and local communities. No financial benefits can be directly linked to implementing water conservation measures as the majority of the lodges do not pay for water per volume. All the lodges had a monitoring procedure in place to measure compliance against the relevant organisation's standard, guidelines or procedures.

5.3 Recommendations

Water quality testing and water quantity measuring

- More frequent and more comprehensive water quality analysis must be carried out on wastewater discharge as well as tap water to ensure water is safe for consumption, and if not, that it is properly communicated to prevent people from accidental consumption. This will also protect the organisations against any liability should a severe water related incident occur.
- Lodge managers should appoint designated personnel to ensure that water meter readings are taken monthly and that they are probably recorded. The use of modern equipment such as pulse meters will prevent meters from seizing. Smart meters can be used to upload data to a cloud where WIFI is available. This will eliminate the issue of human resources being absent or other commitments of the lodge operations.

Baselines and benchmarks

- The baseline and benchmarks in this study can be used at the organisation's discretion. It is unrealistic to expect an upmarket luxury lodge in Botswana to compete against a 4 star or equivalent lodge in Namibia. The author suggests that lodges with an average higher than the country's average to use the average consumption as their benchmark to bring down their consumption. Lodges with an average below the country's average can compete against the best in class benchmark. Since staff play such an integral part in water consumption, the author suggests that the lodges use l/b/n average rather than the l/g/n average.

Stakeholder involvement

- More frequent awareness workshops and presentations for staff could reduce water consumption.

5.4 Contribution of the study

This study will contribute to water management at lodges across Southern Africa as it provides baselines and benchmarks specific to the industry for the first time. The study also provide forecasting formulas to assist organisations in the planning of new lodges and preparing for contingency measures. The study clearly highlights the importance of water quality management and should encourage organisations to actively engage in this activity due its major impacts on human health, eco-systems, local communities and the business itself. This study provides the groundwork for further investigations in water management in the lodge industry across Southern Africa.

5.5 Limitations of the study

Limited and incomplete sets of data limited the results. The remote locations of the lodges, time and financial support also limited site visits to all the lodges to visually observe water management systems. All the lodges that were investigated were high-end, all-inclusive lodges and self-catering lodges were not considered in this study.

5.6 Study conclusion

Globally more than 3,4 million people die every year from water related disease (WHO, 2009), more than the annual death toll of war, terrorism and weapons of mass destruction combined. The wildlife lodge industry is dependent on water for its existence as it serves both its staff and its guests. The majority of the lodges in the wildlife lodge industry measured water consistently over a 24 month period, whereas the minority of the lodges had three or months of missing data. The accuracy of the data was also influenced due to incorrect water meter locations and faulty automated systems. Across all three countries, less than a third of the lodges had tested the water quality of their source, more than half of the lodges tested water quality on their tap and less than a fifth of the lodges tested water quality of their wastewater discharge. From the lodges that did water quality tests on their tap, the majority of the lodges did not test half of the required parameters as stated in the countries relevant standards and guidelines.

The results indicated that the average water consumption across all three countries were very high compared to other countries when the l/g/n were used for comparisons, however when the staff nights were included in the consumption figures, the average l/b/n were very similar to countries such as Greece, USA, Germany, Morocco and many other. The average water consumption from the lodges in Namibia, both in l/g/n and l/b/n, was the lowest from all three countries, whereas the average water consumption in Botswana was highest of the three countries. Government involvement are very limited in the industry across all three countries and all quality monitoring is voluntarily. There is also no limits on the volume of water that is allowed to be abstracted from sources such as rivers, well points or boreholes. Staff and guest are encouraged to use water sparingly, however the success of the current measures has not been evaluated in this study and requires investigation.

Both organisations monitor their current systems and are constantly seeking cost effective ways to improve their performance. Since the cost of water is minimal, it is hard to earn a return on investment by investing in water saving measures and technology. The organisations review their environmental management systems periodically and are continuously looking to improve their environmental performance and water management system.

Since this was the first study to investigate water management in the wildlife lodge industry in South Africa, Namibia and Botswana, the results and analysis of this study will provide lodges and organisations with valuable information with regards to water management in the industry and will aid organisations in their goals of sustainable tourism development. The importance of water quality has been highlighted on various occasions as well as the impacts of over exploiting water sources with regards to human health, local communities, eco-systems and business operations. The baselines and benchmarks will also assist in new developments as it provides information and forecasting formulas which can help organisations to plan their development based on the availability and volume of water. The author also recommend further water management studies that will include other SADC countries such as Zambia, Kenya, Tanzania, Uganda, Mozambique, Angola and Zimbabwe as tourism in these countries also play a major role in the economic and social upliftment of rural communities in the specified region.

References

&Beyond. (2017). www.andBeyond.com [accessed 24 September 2017]

Anisfield, S.G. (2010). *Water resources*. Island press. Washington, DC.

Baker, M. and Mearns, K. (2015). *Sustainable tourism indicators to manage scarce water resources. The Responsible and Sustainable Tourism Handbook. Southern and East Africa.* 13. 51 – 57.

Baoying, N. and Yuanqing, H. (2007). Tourism Development and Water Pollution: Case Study in Lijiang Ancient Town. *China Population, Resource and Environment*. 17(5), 123 – 127.

Becken, S. (2014). Water equity – Contrasting tourism water use with that of the local community. *Water resources and industry*. 7, 9 – 22.

Bond, N., Lake, P. and Arthington, A. (2008). The impacts of drought on freshwater ecosystems: an Australian perspective*. Hydrobiologia*. 600, 1. 3 – 16.

Bridgeford, P., Bridgeford, M. and Berry, H.U. (1997). *Touring Sesriem and Sossusvlei*. P & M Bridgeford. Namibia.

Botswana Bureau of Standards. (2004). *BOS 93:2004 Waste Water Limits*. BBOS. Gabarone.

Botswana Bureau of Standards. (2009). *BOS 32:2009 Drinking Water Standard*. BBOS. Gabarone.

Bushscapes. (2015). *Phinda forest lodge*. Available from http://www.bushscapes.co.za/kwazulu-natal/phinda/phinda-forest-lodge/ [accessed 28 May 2015].

Córcoles, J.I., de Juan, J.A., Ortega, J.F., Tarjuelo, J.M. and Moreno, M.A. (2010). Management evaluation of Water Users Associations using benchmarking techniques. *Agricultural Water Management*. 98, 1 – 11.

Department of Water Affairs and Forestry. (1996). Domestic Water Use. *South African Water Quality Guidelines Vol 1*. Pretoria.

Frankiln, B. (1746). *Poor Richards almanac*. Century Co. New York.

Gleditsch, N.P. (1997). *Conflict and the environment*. Springer. Netherlands.

GoogleMaps. (2016). Available from www.google.co.za/maps [accessed 11 Spetember 2016].

Gössling, S. (2001). The consequences of tourism for sustainable water use on a tropical island Zanzibar, Tanzania. *Journal of Environmental Management*. 61, 2. 179 – 191.

Gössling, S., Peeters, P., Hall, C.M., Ceron, J.P., Dubois, G.,/ Lehmann, L.V. and Scot, D. (2012). Tourism and Water use: Supply, Demand and Security. An International Review. *Tourism Management*. 33, 1 – 15.

Gössling, S., Hall, C.M. and Scott, D. (2015). *Tourism and Water*. Channel View Publications. Ontario.

Grobler, J.J. & Mearns, K.F (2017). Applying water quality as a management tool for the wildlife lodge industry in South Africa and Botswana. In R. Hay (ed.) *Conference Proceedings of BEST EN Think Tank XVII: Innovation and Progress in Sustainable Tourism.* Townsville, Australia: James Cook University, 18-29.

Haigh, E.H., Fox, H., Davies-Coleman, D. and Hughes, D. (2008). The role of local government in Integrated Water Resources Management linked to Water Service Delivery. Rhodes University. Grahamstown.

Hanjra, M.A. and Qureshi, M.E. (2009). Global water crisis and future food security in an era of climate change. *Food policy*. 35, 365 – 377.

Heyd, H. and Neef, A. (2004). Participation of local people in water management: Evidence from the Mae Sa watershed, Thailand. International Food Policy Research Institute. Washington, DC.

Hoekstra A.Y. (2014). Water scarcity challenges to business. *Nature Climate Change*. 4, 318 – 320.

Howard, G. and Bartram, J. (2003). *Domestic water quantity, service and health*. World Health Organization. Geneva. Switzerland.

Intergovernmental Panel on Climate Change. (2007). *Climate Change 2007: Synthesis Report*. IPCC. Geneva.

International Tourism Partnership (ITP). (2008). *Environmental management for hotels: The industry guide to sustainable operation (Third edition)*. ITP. London.

Khan, S., Shahnaz, M., Jehan, N., Rehman, S., Shah, M.T. and Din, I. (2013). Drinking water quality and human health risk in Charsadda district, Pakistan. *Journal of cleaner production*. 60, 93 – 101.

Kuss, F.R., Graefe, A.R. and Vaske, J.J. (1990). *Visitor Impact Management. A review of research, (Vol 1)*. National Parks and Conservation Association. Washington, DC.

LaVanchy, G.T. (2017). When wells run dry: Water and Tourism in Nicaragua. *Annals of Toursim*. 64, 37 – 50.

Mearns, K. and Grobler, H. (2016). Managing Water for Tourism in the Phinda Private Nature Reserve, KwaZulu-Natal, South Africa, Athens: ATINER'S Conference Paper Series, No: WAT2016-2022., 4th Annual International Forum on Water, Athens, Greece 11 July-14July 2016, ISSN 2241-2891, 1-23.

Molina-Azorín, J. F., Tarí, J.J., Pereira-Moliner, J., Lopez-Gamero, M.D. and Pertusa-Ortega, E.M. (2015). The Holy Grail: Environmental management, competitive advantage and business performance in the Spanish hotel industry.*Tourism Management*. 50, 41 – 54.

Mouton, J. (2001). *How to succeed in your Master's & Doctoral Studies*. Van Schaik. Pretoria.

Muńoz, I. and Fernandez-Alba, A. R. (2007). Reducing the environmental impacts of reverse osmosis desalination by using brackish groundwater resources. *Water Research*. 42, 801 – 811.

National Geographic, (2015). *Freshwater crisis*. Available from http://environment.nationalgeographic.com/ environment/freshwater/freshwater-crisis/ [accessed 21 May 2015].

National Water Act no 36 of 1998. (1998). South Africa.

National Water Act no 54 of 1956. (1956). Namibia.

Occupational Health and Safety Act no 85 of 1993, s (8). South Africa.

Rahmstorf, S. (2010). A new view on sea level rise. *Nature Reports Climate Change*, 6 April.

Saagi, R., Kroll, S., Flores-Alsina, X. and Jeppson, U. (2017). A model library for simulation and benchmarking of integrated urban wastewater systems*. Environmental Modeling and Software*. 93, 282 – 295.

Schlosser, C.A., Strzepel, K., Xiang, G., Fant, C., Blanc, E., Paltsev, S., Jcoby, H., Reily, J. and Gueneau, A. (2014). *The future of global water stress: An integrated assessment*. Cambridge, MA: Joint Program on the science and Policy of Global Change, Massachusetts Institute of Technology.

Serageldin, I. (2009). Water: Conflicts set to arise within as well as between states. *Nature*. Vol 459. 163

South African Bureau of Standards. (2015). *South African National Standard (241) for drinking water.* SABS. Pretoria.

Styles, D., Schoenberger, H. and Galvez-Martos, J.L. (2015). Water management in the European hospitality sector: Best practice, performance benchmarks and improvement potential. *Tourism Management*. 46, 187 – 202.

Timbavati Private Nature Reserve. (2017). *The Greater Kruger National Park*. Available from http://timbavati.co.za/the-kruger-national-park-2/ [accessed 24 June 2017).

United Nations Water. (2016).*The United Nations World Water Development Report, 2016*. Paris: United Nations.

Venter, L. (2017). *Cape Town hotels respond to increased water restrictions*. Daily Southern and East African Tourism Update. 5 September 2017. Available from http://www.tourismupdate.co.za/article/125833/Cape-Town-hotels-respond-to-increased-water-restrictions [accessed 17 January 2018).

Vogelsang, R. (2000). Archaeological investigations in the Kaokoland: survey and excavations in 1999 and 2000. University of Calgary. Canada.

Walmsley, B. and Patel, S. (2011). *Handbook on environmental assessment legislation in the SADC region (3rd edition)*. Pretoria: Development Bank of Southern Africa (DBSA) in collaboration with the Southern African Institute for Environmental Assessment (SAIEA).

Watkeys, M.K., Mason, T.R. and Goodman, P.S. (1993). The role of geology in the development of Maputaland, South Africa. Journal of African Earth Sciences (and the Middle East. 16, 205 – 221.

Wilderness Safaris. (2017). *Agents Manual 2017*. Wilderness Safaris. Sandton.

World Health Organisation. (2009). *Waterborne disease is World's leading killer*. WHO. Geneva.

Appendix A: Question guide for semi-structured interviews

1. What are government's involvement with regards to water quality and quantity?
2. How do you create awareness and involve staff in your water management system?
3. How do you create awareness and involve guests in your water management system?
4. How do you create awareness and involve local communities in your water management system?
5. What water conservation measures have you implemented and identified?
6. What are the financial benefits from saving water at the lodges?
7. Would a cost-benefit analyses be applicable?
8. How do you monitor your water management system?

Appendix B: SANS 241: 2015 Drinking Water Standard (South Africa)

MICROBIOLOGICAL DETERMINANDS		
	Risk	Limits
E.coli or Fecal coliforms count/100ml	health	Not detected
Cytosporidium species count/10mL	health	Not detected
Giardia species count/10mL	health	Not detected
Total coliforms count/100ml.	operational	< 10
Heterotrophic plate count count/1ml	operational	< 1000
PHYSICAL, AESTHETIC, OPERATIONAL AND CHEMICAL DETERMINANDS		
Free chlorine mg/L	health	≤ 5
Monochloramine mg/L	health	≤ 3
Colour Pt-Co	aesthetic	< 15
Conductivity at 25degC mS/m	aesthetic	≤ 170
Total dissolved solids mg/L	aesthetic	≤ 1200
Turbidity	operational	≤ 1
	aesthetic	≤ 5
pH at 25degC	operational	≥ 5 and ≤ 9.7
Nitrate as N mg/L	health	≤ 11
Nitrite as N mg/L	health	≤ 0.9
Nitrate-Nitrite ratio		≤ 1
Sulfate as $SO4^-$ mg/L	health	≤ 500
	aesthetic	≤ 250
Fluoride as F^- mg/L	health	≤ 1.5
Ammonia as N mg/L	aesthetic	≤ 1.5

Chloride as Cl^- mg/L	aesthetic	≤ 300
Sodium mg/L	aesthetic	≤ 200
Zinc mg/L	aesthetic	≤ 5
Antimony μg/L	health	≤ 20
Arsenic μg/L	health	≤ 10
Barium μg/L	health	≤ 700
Boron μg/L	health	≤ 2400
Cadmium μg/L	health	≤ 3
Chromium μg/L	health	≤ 50
Cobalt μg/L	health	≤ 500
Copper μg/L	health	≤ 2000
Cyanide μg/L	health	≤ 200
Iron μg/L	health	≤ 2000
	aesthetic	≤ 300
Lead μg/L	health	≤ 10
Manganese μg/L	health	≤ 400
	aesthetic	≤ 100
Mercury μg/L	health	≤ 6
Nickel μg/L	health	≤ 70
Selenium μg/L	health	≤ 40
Uranium μg/L	health	≤ 30
Vanadium μg/L	health	≤ 200
Aluminium μg/L	operational	≤ 300
Total organic carbon mg/L	health	≤ 10
Chloroform μg/L	health	≤ 300
Bromoform μg/L	health	≤ 100
Dibromochloromethane μg/L	health	≤ 100
Bromodichloromethane μg/L	health	≤ 60
Trihalomethane ratio		≤ 1
Microcystin μg/L	health	≤ 1
Phenols μg/L	aesthetic	≤ 10

Appendix C: Wastewater limits as per Nation Water Act, Government Gazette No. 20526, 8 October 1999 (South Africa)

SUBSTANCE/PARAMETER	GENERAL LIMIT	SPECIAL LIMIT
Faecal Coliforms (per 100 ml)	1 000	0
Chemical Oxygen Demand (mg/l)	75*	30*
pH	5,5-9,5	5,5-7,5
Ammonia (ionised and un-ionised) as Nitrogen (mg/l)	3	2
Nitrate/Nitrite as Nitrogen (mg/l)	15	1,5
Chlorine as Free Chlorine (mg/l)	0,25	0
Suspended Solids (mg/l)	25	10
Electrical Conductivity (mS/m)	70 mS/m above intake to a maximum of 150 mS/m	50 mS/m above background receiving water, to a maximum of 100 mS/m
Ortho-Phosphate as phosphorous (mg/l)	10	1 (median) and 2,5 (maximum)
Fluoride (mg/l)	1	1
Soap, oil or grease (mg/l)	2,5	0
Dissolved Arsenic (mg/l)	0,02	0,01
Dissolved Cadmium (mg/l)	0,005	0,001
Dissolved Chromium (VI) (mg/l)	0,05	0,02
Dissolved Copper (mg/l)	0,01	0,002
Dissolved Cyanide (mg/l)	0,02	0,01
Dissolved Iron (mg/l)	0,3	0,3
Dissolved Lead (mg/l)	0,01	0,006
Dissolved Manganese (mg/l)	0,1	0,1
Mercury and its compounds (mg/l)	0,005	0,001
Dissolved Selenium (mg/l)	0,02	0,02
Dissolved Zinc (mg/l)	0,1	0,04
Boron (mg/l)	1	0,5

Wastewater limits applicable for irrigation up to 50m³, RSA

Variables	Limits
pH	not less than 6 or more than 9 pH units
Electrical conductivity	not exceed 200 milliSiemens per metre (mS/m);
Chemical Oxygen Demand (COD)	does not exceed 5000 mg/l after removal of algae;
Faecal coliforms	do not exceed 100 000 per 100 ml
Sodium Adsorption Ratio (SAR) -	does not exceed 5 for biodegradable industrial wastewater

Wastewater limits applicable for irrigation up to 500m³, RSA

Variables	Limits
pH	not less than 6 or more than 9 pH units
Electrical conductivity	not exceed 200 milliSiemens per metre (mS/m);
Chemical Oxygen Demand (COD)	does not exceed 400 mg/l after removal of algae;
Faecal coliforms	do not exceed 100 000 per 100 ml
Sodium Adsorption Ratio (SAR)	does not exceed 5 for biodegradable industrial wastewater

Wastewater limits applicable for irrigation up to 2000m³, RSA

Variables	Limits
pH	not less than 5,5 or more than 9,5 pH units
Electrical Conductivity	does not exceed 70 milliSiemens above intake to a maximum of 150 milliSiemens per metre (mS/m)
Suspended Solids	does not exceed 25 mg/l
Chloride as Free Chlorine	does not exceed 0,25 mg/l
Fluoride	does not exceed 1 mg/l
Soap, Oil and Grease	does not exceed 2,5 mg/l
Chemical Oxygen Demand	does not exceed 75 mg/l
Faecal coliforms	do not exceed 1000 per 100 ml
Ammonia (ionised and un-ionised) as Nitrogen	does not exceed 3mg/l
Nitrate/Nitrite as Nitrogen	does not exceed 15 mg/l
Ortho-Phosphate as phosphorous	does not exceed 10 mg/l

Appendix D: Drinking water quality standards as per National Water Act (Act 54 of 1956), Namibia

Aesthetic and physical requirements, Namibia

DETERMINANTS	UNITS	LIMITS FOR GROUPS			
		A	B	C	D*
Colour	mg/l Pt**	20			
Conductivity	mS/m 25 C	150	300	400	400
	25/ALT + 248/C				
Total hardness	mg/l $CaCO_3$	300	650	1300	1300
Turbidity	N.T.U***	1	5	10	10
Chloride	mg/l Cl	250	600	1200	1200
Chlorine (free)	mg/l Cl	0,1- 5,0	0,1 – 5,0	0,1 – 5,0	5,0
Fluoride	mg/l F	1,5	2,0	3,0	3,0
Sulphate	mg/l SO_4	200	600	1200	1200
Copper	µg/l Cu	500	1000	2000	2000
Nitrate	mg/l N	10	20	40	40
Hydrogen Sulphide	µg/l H_2S	100	300	600	600
Iron	µg/l Fe	100	1000	2000	2000
Manganese	µg/l Mn	50	1000	2000	2000
PH****	pH-unit	6,0 – 9,0	5,5 – 9,5	4,0 – 11,0	4,0 – 11,0

Bacteriological requirements, Namibia

DETERMINANTS	LIMITS FOR GROUPS			
	A**	B**	C	D*
Standard plate counts per 1 ml	100	1000	10000	10000
Total coliform counts per 100 ml	0	10	100	100
Faecal coliform counts per 100 ml	0	5	50	50
E. coli counts per 100 ml	0	0	10	10

Inorganic determinants, Namibia

DETERMINANTS	UNITS	LIMITS FOR GROUPS			
		A	B	C	D*
Aluminium	μg/l Al	150	500	1000	1000
Ammonia	mg/l N	1	2	4	4
Antimonia	μg/l Sb	50	100	200	200
Arsenic	μg/l As	100	300	600	600
Barium	μg/l Ba	500	1000	2000	2000
Beryllium	μg/l Be	2	5	10	10
Bismuth	μg/l Bi	250	500	1000	1000
Boron	μg/l B	500	2000	4000	4000
Bromine	μg/l Br	1000	3000	6000	6000
Cadmium	μg/l Cd	10	20	40	40
Calcium	mg/l Ca	150	200	400	400
Calcium	mg/l $CaCO_3$	375	500	1000	1000
Cerium	μg/l Ce	1000	2000	4000	4000
Chromium	μg/l Cr	100	200	400	400
Cobalt	μg/l Co	250	500	1000	1000
Cyanide (free)	μg/l CN	200	300	600	600
Gold	μg/l Au	2	5	10	10
Iodine	μg/l I	500	1000	2000	2000
Lead	μg/l Pb	50	100	200	200
Lithium	μg/l Li	2500	5000	10000	10000
Magnesium	mg/l Mg	70	100	200	200
Magnesium	mg/l $CaCO_3$	290	420	840	840
Mercury	μg/l Hg	5	10	20	20
Molybdenum	μg/l Mo	50	100	200	200
Nickel	μg/l Ni	250	500	1000	1000
Phosphate	mg/l P	1	See note below	See note below	See note below
Potassium	mg/l K	200	400	800	800
Selenium	μg/l Se	20	50	100	100
Silver	μg/l Ag	20	50	100	100
Sodium	mg/l Na	100	400	800	800
Tellurium	μg/l Te	2	5	10	10
Thallium	μg/l Tl	5	10	20	20
Tin	μg/l Sn	100	200	400	400
Titanium	μg/l Ti	100	500	1000	1000
Tungsten	μg/l W	100	500	1000	1000
Uranium	μg/l U	1000	4000	8000	8000
Vanadium	μg/l V	250	500	1000	1000

Appendix E: Wastewater limits as per National Water Act (Act 54 of 1956), Namibia

General standards for effluent discharge, Namibia.

DETERMINANTS	MAXIMUM ALLOWABLE LEVELS
Arsenic	0,5 mg/l as As
Biological Oxygen Demand (BOD)	no value given
Boron	1,0 mg/l as B
Chemical Oxygen Demand (COD)	75 mg / l as O
Chlorine, residual	0,1 mg/l as Cl_2
Chromium, hexavalent	50 µg/l as Cr(VI)
Chromium, total	500 µg/l as Cr
Copper	1,0 mg/l as Cu
Cyanide	500 µg/l as CN
Oxygen, Dissolved (DO)	at least 75% saturation**
Detergents, Surfactants, Tensides	0,5 mg/l as MBAS – See also Note 2
Fats, Oil & Grease (FOG)	2,5 mg/l (!gravimetric method)
Fluoride	1,0 mg/l as F
Free & Saline Ammonia	10 mg/l as N
Lead	1,0 mg/l as Pb
Oxygen, Absorbed (OA)	10 mg / l as O*
pH	5,5 – 9,5
Phenolic Compounds	100 µg/l as phenol
Phosphate	1,0 mg/l as P - See also Note 1
Sodium	not more than 90 mg/l Na more than influent
Sulphide	1,0 mg/l as S
Temperature	35°C
Total Dissolved Solids (TDS)	not more than 500 mg /l more than influent
Total Suspended Solids (TSS)	25 mg/l
Typical faecal Coli.	no typical coli should be counted per 100 ml
Zinc	5,0 mg/l as Zn

Appendix F: BOS 32: 2009 Drinking water quality standard, Botswana

Microbiological requirements, Botswana

Determinant	Acceptable limit	Frequency of testing	Test method
Total coliform	Absent in 100 ml	Initially then weekly	BOS ISO 9308-1 or BOS ISO 9308-2
Faecal coliform (including *Escherichia coli*)	Absent in 100 ml	Initially then weekly	BOS ISO 9308-1 or BOS ISO 9308-2
Total viable colony [a]	100 per 1 ml (maximum)	Initially then weekly	BOS ISO 8199
Enterococcus	Absent in 100 ml	Initially then weekly	BOS ISO 7899-2
Moulds	Absent in 100 ml	Initially then weekly	BOS ISO 8199
Pseudomonas aeruginosa	Absent in 100 ml	Initially then monthly	ISO 16266
Clostridium spores	Absent in 100 ml	Initially then monthly	ISO 6461-1 or ISO 6461-2
Cryptosporidium and *Giardia*	Absent in 10 litres	During rainy season or when there is an outbreak of water borne diseases	BOS ISO 15553
[a] Total viable colony shall be tested at 22 °C and 37 °C within 24 h after bottling with the water being maintained at 4 °C ± 3 °C during this period			

Contaminants, Botswana

Contaminant	Risk category	Acceptable limit	Frequency of testing	Test method
Phenolic compounds	health	<5 µg/ ℓ	Initially then every six months	BOS ISO 6439
Organochlorine pesticides and PCB's	health	Not detectable [a]	Initially then every six months	APHA method 6630 B
Organophosphate pesticides	health	Not detectable [a]	Initially then every six months	AOAC method 991.07
Cyanide	health	Not more than 0.07 mg/ ℓ, calculated as CN	Initially then every six months	SANS 5204 (SABS SM 204)
Nitrite	health	Not more than 0.01 mg/ ℓ, calculated as N	Initially then every six months	BOS ISO 10304-1
NOTE Test methods that deliver equal or better results may be substituted for those listed in column 5. [a] Not detectable by the method specified				

Physical and macro requirements, Botswana

Determinant	Risk category	Limits (maximum)	Frequency of testing
pH	health	5.5 to 9.5 for still water	Daily
Colour	aesthetic	15 TCU	Daily
Turbidity	aesthetic / operational	5 NTU	Daily
Electrical conductivity	aesthetic	1500 μS/cm	Daily
Total Dissolved Solids	aesthetic	1 000 mg/ℓ	Initially then quarterly
Calcium as Ca	aesthetic / operational	150 mg/ℓ	Initially then quarterly
Chloride as Cl	aesthetic	200 mg/ℓ	Initially then quarterly
Fluoride as F	health	1.0 mg/ℓ calculated as F	Initially then quarterly
Magnesium as Mg	aesthetic / health	70 mg/ℓ	Initially then quarterly
Potassium as K	operational / health	50 mg/ℓ	Initially then quarterly
Sodium as Na	aesthetic / health	200 mg/ℓ	Initially then quarterly
Sulfate as SO_4	health	250 mg/ℓ	Initially then quarterly

Micro determinants, Botswana

Determinant	Risk category	Limits (maximum)	Frequency of testing
Aluminium as Al	health	0.20 mg/ℓ	Initially then quarterly
Antimony as Sb	health	0.020 mg/ℓ	Initially then quarterly
Arsenic as As	health	0.01 mg/ℓ	Initially then quarterly
Barium as Ba	health	1.0 mg/ℓ	Initially then quarterly
Borate as total Boron	health	5 mg/ℓ	Initially then quarterly
Cadmium as Cd	health	0.003 mg/ℓ	Initially then quarterly
Chromium as Cr	health	0.05 mg/ℓ	Initially then quarterly
Copper as Cu	health	2.0 mg/ℓ	Initially then quarterly
Iron as Fe	aesthetic /operational	0.3 mg/ℓ	Initially then quarterly
Lead as Pb	health	0.01 mg/ℓ	Initially then quarterly
Manganese as Mn	aesthetic	0.1 mg/ℓ	Initially then quarterly
Mercury as Hg	health	0.006 mg/ℓ	Initially then quarterly
Nickel as Ni	health	0.07 mg/ℓ	Initially then quarterly
Nitrate as NO_3	health	50 mg/ℓ [a]	Initially then quarterly
Selenium as Se	health	0.01 mg/ℓ	Initially then quarterly
Zinc as Zn	health	5.0 mg ℓ	Initially then quarterly
Organic matter calculated as O_2 absorbed	health	3.0 mg/l	Initially then quarterly

[a] 50 mg /l as NO_3 converts to 11 mg/l as N.

Appendix G: BOS 93: 2004 Wastewater quality standard, Botswana

Wastewater quality standard, Botswana

Physical and microbiological requirements		
Parameter	**Units**	**Maximum allowable discharge for wastewater**
Temperature	°C	35
pH	units	6.0 - 9.0 units
Dissolved oxygen	%	60
Biological oxygen demand (max.)	mg/l	30
Chemical oxygen demand (filtered) (max.)	mg/l	75
Colour	TCU	50
Total dissolved solids	mg/l	2 000
Total suspended solids	mg/l	25
Faecal coliform	Count/100 ml	1 000
Chemical requirements		**Inorganic macro-determinants (mg/l)**
Free and saline ammonia as N		10
Orthophosphate as P or soluble phosphate		1.5
Calcium as Ca		500
Chloride as Cl		600
Residual chlorine		1.0
Fluoride as F		1.5
Nitrate as N		22
Potassium as K		100
Sodium as Na		400
Sulphate as SO_4		400
Zinc as Zn		5.0
Chemical requirements		**Inorganic micro-determinants (μg/l)**
Arsenic as As		0.10
Boron as B		0.50
Cadmium as Cd		0.02
Chromium VI as Cr		0.25
Chromium (total) as Cr		0.50
Cobalt as Co		1.00
Copper as Cu		1.00
Cyanide as CN		0.10
Iron as Fe		2.00
Lead as Pb		0.05
Manganese as Mn		0.10
Mercury as Hg		0.02
Nickel as Ni		0.30
Selenium as Se		0.02

Appendix H: Approved ethics from UNISA

UNISA university of south africa

CAES RESEARCH ETHICS REVIEW COMMITTEE

National Health Research Ethics Council Registration no: REC-170616-051

Date: 25/11/2016

Ref #: **2016/CAES/120**
Name of applicant: **Mr JJ Grobler**
Student #: **50963708**

Dear Mr Grobler,

Decision: Ethics Approval

Proposal: Investigating water management and benchmarking water use for the wildlife lodge industry in South Africa, Namibia and Botswana

Supervisor: Prof K Mearns

Qualification: Postgraduate degree

Thank you for the application for research ethics clearance by the CAES Research Ethics Review Committee for the above mentioned research. Approval is granted for the project.

Please note that the approval is valid for a one year period only. After one year the researcher is required to submit a progress report, upon which the ethics clearance may be renewed for another year.

Due date for progress report: 30 November 2017

Please note points 4 to 6 below for further action.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the CAES Research Ethics Review Committee on 24 November 2016.

The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the CAES Research Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*
3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*
4) *The Wilderness Safaris permission letter is signed, but the name or capacity of the person that signed is not provided. The researcher must clarify who signed the letter.*
5) *The researcher must adhere to the stipulations in the permission letter from Wilderness Safaris.*
6) *The researcher is advised to provide regular feedback to the research partners on the findings to ensure that it is acceptable to use the information.*

Note:

The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the CAES RERC.

Kind regards,

Signature
CAES RERC Chair: Prof EL Kempen

Signature
CAES Executive Dean: Prof MJ Linington

NB No's 4 - 6

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

Appendix I: &Beyond consent letter

&BEYOND

9th September 2016

Dear Mr. JJ Grobler

In my capacity as &Beyond's Group Sustainability Manager, we accept your request and proposal to have &Beyond as your research partner for the Masters study: "Benchmarking *indicators for sustainable water use for the tourism sector in South Africa, Botswana and Namibia*". We hereby give you full permission and consent to use our data, analyse data and publish the results.

The motivation for our decision is due to certain points you highlighted in your consent request letter (7 September 2016) and the following conditions will be adhered at all times:

- The UNISA's Ethical Code of Conduct
- All the conditions in the Memorandum of Agreement (MOA) already established between &Beyond and UNISA
- Protecting the organisation, its members, executives and personnel that will be involved
- All documentation would need to be proofed by andBeyond before publication

Failure to comply with any of the conditions in the documents as stated above can result in &Beyond withdrawing from the project / research.

Since we have already been involved with your Honours study in 2015, we are also confident that the project will be a major success and will have mutual benefits for all parties involved. It is a great privilege to be involved in this study and we would like to wish you all the best for the project.

Kind Regards

Mr. Jonathan Braack
(Group Sustainability Manager, &Beyond)

Appendix J: Wilderness Safaris consent letter

WILDERNESS
SAFARIS

15th September 2016

This letter serves to confirm that Mr. JJ Grobler will be conducting a Master's study on *"Benchmarking indicators for sustainable water use for the tourism sector in South Africa, Botswana and Namibia"*. The study will be supervised by Prof. KF Mearns from the University of South Africa (UNISA).

Wilderness Safaris grants JJ Grobler permission to obtain, analyse and publish our data. The data will be supplied by Warren Ozorio from Wilderness Safaris directly to JJ Grobler. The data collected can only be used for research purposes and should be analysed in a professional, impartial, ethical and unbiased manner.

Wilderness Safaris is to be acknowledged, in the Master's dissertation and any related published or unpublished materials.

JJ Grobler is to share the final version of the Master's dissertation with Wilderness Safaris prior to submission, as well as a copy of the final revised version and any related materials where the data is used.

As agreed upon verbally, Wilderness Safaris will host a researcher at selected camps at our cost. In return, a formal presentation must be offered to our guests and staff in camp.

Signed – Wilderness Safaris

15.09.2016
Date