MANAGING WATER AND SANITATION IN THE FISH RIVER BASIN:

The Potential for the Basin Management Approach

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ABSTRACT

The purpose of this report was to assess the potential for the implementation of a Basin Management Approach in the Fish River Basin in Namibia. Using information collected from interviews with local authorities, community representatives and water and sanitation experts, our results provide a detailed overview of the state of water and sanitation in this basin. From these results we developed a list of recommendations that should be considered in the creation of effective and capable basin management.

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Each group member contributed equally in the writing of this final report and to the project in general, including but not limited to interview protocols, interviews and analysis of all data.

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LIST OF ACRONYMS

ADB	African Development Bank
BMA	Basin Management Approach
BMC	Basin Management Committee
CBNRM	Community Based Natural Resource Management
CEO	Chief Executive Officer
DEWATS	Decentralized Wastewater Treatment System
DRFN	Desert Research Foundation of Namibia
ELAK	The Environmental Learning and Action in the Kuiseb Project
ERB-SADC	Ephemeral River Basin-Southern Africa Development Community; the project in the SADC focusing on water basin management in three basins in Southern Africa
FRB	Fish River Basin
HRDC	Habitat Research and Development Center
IWRM	Integrated Water Resources Management
MDG	Millennium Development Goals
NEPAD	New Partnership for African Development
SADC	Southern Africa Development Community
UN	United Nations
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit toilet
WASP	Water Supply and Sanitation Sector Policy, declared in Namibia in 1993

GLOSSARY

Aquifer	An underground water-bearing layer of permeable rock, sand, or gravel
Bush	Outdoor areas used as a communal toilet
Cost Recovery	The act of recovering the costs associated with providing a service – in this case, water and sanitation services.
Ephemeral River	Any river in which water flows in during only part of the year
Formal Areas	Residential area of town with permanent structures, usually with basic municipal services such as water and sanitation connections, as well as electricity
Informal Settlement	The residential area of town where basic municipal services such as water and electricity are not always guaranteed and houses and other structures are not always permanent; generally identified by the local authority
Intertropical Convergence Zone	A belt of low pressure which is located at the equator, and is formed by the vertical ascent of warm, moist air
NamWater	Namibia Water Corporation, founded in 1997 with the charge of providing bulk water throughout Namibia
Stakeholder	A person or organization with an influence on water within the basin, including users and water distributors
Subtropical High Pressure Zone	A belt of high pressure, which lies below the Intertropical Convergence Zone, and contains dry air
Urban Area	An area with a settled population and some form of local governance, including settlements, villages, towns, mining towns, and municipalities.

EXECUTIVE SUMMARY

Namibia's Fish River Basin (FRB) is the largest river basin in Namibia, and also located in the most arid region of the country. The FRB is the focus of a project being undertaken by the Desert Research Foundation of Namibia (DRFN), which has played a major role in promoting the Basin Management Approach (BMA) as a solution to water and sanitation issues throughout the country. Ideally, the stakeholders in the FRB water system – the bulk water provider, local leaders, and community members – would act cooperatively to ensure a sustainable water supply and effective sanitation throughout the basin. However, an effective, basin-wide management system does not yet exist.

The objectives of this project were to study the urban areas in the FRB to:

- Identify the water sources and sanitation methods in the urban areas;
- Acquire raw data on the amount of water supplied, used, and unaccounted for in each urban area;
- Determine and examine the water tariff systems and cost recovery programs in each urban area;
- Identify the local perceptions on water and sanitation;
- Assess the potential for the Basin Management Approach in the FRB

BACKGROUND

The Basin Management Approach (BMA) is a community-based management system based on the decentralization of control (DRFN, 2005) and the coordination of the water use of all stakeholders in the basin. Water issues cannot be understood without a close look at sanitation, because many sanitation methods are dependent upon an adequate supply of water. Additionally, human waste has the potential to contaminate ground and surface water when sanitation methods are inadequate or improperly used. Regardless of size, shape or political boundaries, a basin should be considered as one unit for water management to be most effective.

METHODS

The goal of the project was to assess the potential for the Basin Management Approach to manage water and sanitation in the Fish River Basin (FRB). The project was carried out in three stages, including expert interviews in Windhoek; a two-week field expedition where we interviewed local water authorities, regional authorities, NamWater, and community representatives; and an analysis of water and sanitation management in the FRB, as well as the necessary prerequisites for implementing a successful Basin Management Committee.

RESULTS & ANALYSIS

We analyzed our research results according to the following categories: water, sanitation, tariffs and cost recovery, management within the local authorities, and communication within the basin.

Water sources, infrastructure, and quality were the focus of much of our research. The main sources of water in the Fish River Basin are dams and boreholes, though most urban areas are looking into alternative, unpurified sources of water for uses other than drinking to reduce costs to the consumer. Health risks arise with the use of these sources if consumers use the cheaper, but potentially unsafe water for drinking. Aging infrastructure and corroding asbestos pipes lead to water losses and lost revenue for the local authorities. However, these problems are not being dealt with effectively due to the lack of skilled maintenance personnel in each urban area. Although a NamWater representative noted fluorides, nitrates, sulfates, and high salinity as affecting groundwater quality in the basin, this does not pose a serious health risk to communities in the FRB.

Methods of sanitation vary greatly in and among the urban areas that we visited. Of these eleven locations, six make some use of pit or bucket toilets, while seven are at least partly served by modern sewerage systems. Dry sanitation methods are in use in all but two of the visited locations, the bucket system being the most common. The clearest sanitation problem in the FRB is the use of the bush and bucket systems, primarily in informal settlements. Problems with wet sanitation in the Fish River basin are few, although their reliance upon a steady and large water supply makes their appropriateness for the FRB uncertain. The most obvious sanitation successes are in Keetmanshoop and Karasburg, where nearly every household has access to an individual sewerage connection, including those in the informal areas.

During our fieldwork, we saw what seems to be a clear hierarchy of sanitation methods being used in the FRB. Flush toilets connected to a sewerage system are taken to be the best available method by planners, followed by septic systems, pit toilets, and buckets. The only lateral deviations from this scheme are in Maltahöhe and Mariental, which are looking to run pilot projects with the Otji Toilet, and Keetmanshoop, where dry sanitation toilets are used at the golf course and at a woodcarvers market. In no case is an alternative sanitation method being used on a large scale or in a way that is integrated into a larger plan for resource management. The strongest overall trend that we observed in sanitation development is a move towards waterborne sewerage systems.

Cost recovery is a major issue in the FRB due to the non-affordability of water and lack of consistency in payment programs. Consumer water rates vary depending on location in the basin, distance from the water source, original quality of the water, and the NamWater rates imposed on the local authority. Nonpayment of water and sanitation bills stems largely from the high unemployment rates in the basin, and from cost recovery systems and payment plans that are not enforced regularly.

The authorities generally consider the water tariffs to be fair and affordable despite the fact that many consumers are indebted to the local authorities, which are, in turn, indebted to NamWater. Many see prepay meters as the answer to all cost recovery issues, because if the users do not have enough money to pay for water, they do not have access. The local authorities generally consider their relationship with NamWater to be a good one.

Many of the data requested from the local authorities were not available because of poor record keeping. A lack of training in the areas of accounting and management and the high turnover rate of local officials compounded record keeping issues. In some cases, such

as between the settlement offices and the Regional Council, a lack of communication is complicating billing situations and creating problems for the settlement office.

Communication remains an important issue in the FRB and this must improve if a Basin Management Approach can be effective. Channels already exist between NamWater and many local authorities, and in many locations forums are set up so that the local government can communicate with the community. People in the basin were positive about the potential of a Basin Management Committee in the FRB. However, some of the experts interviewed did have reservations about the feasibility of decentralization at all levels, but did have suggestions on how it could be done for some purposes.

CONCLUSIONS & RECOMMENDATIONS

The recommendations we presented to the DRFN, local and regional authorities, and councils in the FRB were developed to benefit the implementation of the Basin Management Approaching order to manage water and sanitation issues more successfully.

For a Basin Management Committee (BMC) to be effective, stakeholders must agree on a transparent, congruent record keeping system to be used in the basin. To better assess how well local authorities are operating, we recommend a set of qualitative performance indicators be established based on these data. Good communication between local authorities is also key to the formation and longevity of a productive and powerful BMC.

Cost recovery systems in the basin will improve with better management practices and a willingness to explore new options that have worked in the past. We recommend regular training for local authorities about effective cost recovery systems and communication about the importance of payment to the consumers. Improving current payment plans or introducing new ones will help consumers manage water use and bill payment.

The BMC could assist in implementing cooperative basin-wide approaches to beneficial pilot projects. Through the BMC, collaborative training programs could regularly improve the skills of local employees and enhance the capacity of the local authorities in the FRB. If the urban areas work together, joint training programs could be implemented at a lower cost to each community.

A BMC could assist with sustainable resource management in the Fish River Basin. Using brackish groundwater, gray water, or other unpurified sources for non-consumption purposes and exploring alternative sanitation systems to save water and generate new economic value are two good examples, but community members must be actively involved in projects being implemented in urban areas.

If basin management is to be truly effective, water managers at all levels should treat basins as whole and distinct policy regions. Dividing the basin into two management sub-committees, disregarding the Hardap-Karas borders, may be appropriate, as the basin's large area makes communication and meetings difficult for some important stakeholders. This division should be designed to enhance the logistics of basin management for stakeholders, and to preserve a broad representation of different kinds of stakeholders in each sub-committee.

SUMMARY

The analysis, recommendations and conclusions of this report were submitted to the Desert Research Foundation of Namibia with the hope that it will assist in the overall knowledge of water and sanitation issues and in the implementation of a basin management committee in the Fish River Basin.

1 INTRODUCTION

Ensuring access to clean water is one of the most pressing human rights issues in Africa, where almost every conceivable problem associated with water management is manifest: famines caused by flood and drought (UN Office for the Coordination of Humanitarian Affairs, 2007), water-borne disease outbreaks (Barrow, 2001), social unrest caused by competition in and among nations for scarce water (BBC News, 2006), and environmental degradation resulting from unsustainable exploitation of water resources (Hanna, 1997). The United Nations has recognized the importance of water management in the Millennium Development Goals (MDGs), established in September of 2000 (United Nations, 2000), which include decreasing the number of people without clean water by half by the year 2015. Additionally, the years of 2005 to 2015 are an International Decade for Action: "Water For Life" (United Nations, 2008), with 2008 having special emphasis as the International Year of Sanitation.

In Namibia, the driest country in sub-Saharan Africa, water management is an important issue. Although sporadic flooding occurs (Shigwedha, 2008), water scarcity due to recurrent droughts and generally inconsistent rainfall is one of the contributing factors limiting socio-economic development throughout the country, especially in the south. The Fish River Basin (FRB) in southern Namibia is the focus of a project being implemented by the Desert Research Foundation of Namibia (DRFN). The DRFN has played a major role in promoting the Basin Management Approach (BMA) as a solution to water and sanitation issues in Namibia's vast rural areas. Ideally, the many stakeholders in the FRB – bulk water providers, regional councils, local authorities, and community members – would act cooperatively to ensure a sustainable water supply throughout the basin, but a strong, basin-wide management system does not yet exist.

Efforts to implement effective water management systems have been ongoing and successful in Namibia and in other parts of the world. In Kazakhstan, for instance, Integrated Water Resource Management (IWRM) strategies have taken root after government promotion, and cross-subsidization programs in Chile have made delivery of water services affordable for both consumers and the government (United Nations Development Programme, 2008; Foster & Yaps, 2006). In Africa, the Norwegian Department of Foreign Affairs is sponsoring projects in two ephemeral river basins outside of Namibia – the Boteti River Basin in Botswana and the Buffels River Basin in South Africa (DRFN, 2005). Within

Namibia, a major achievement has been the DRFN's work in the Kuiseb River Basin, which resulted in the establishment of the first basin management committee in Namibia to oversee the management of water resources. The Kuiseb River Basin was an appropriate starting point for the DRFN's work, as the organization has long had a presence there (Gobabeb, 2007).

The FRB, the largest and most arid ephemeral river basin in Namibia, could benefit greatly from improved water management, but whether or not this is a feasible solution has yet to be explored. Examining the potential for water and sanitation management in the FRB entails a great deal of research. A general expertise in water management and ecology in arid climates is essential, as is a familiarity with Namibia's large-scale water and sanitation infrastructure, implementing institutions and policies and people's perceptions. The DRFN, as one of the premier institutions of research on land and water management in Namibia, has much of this knowledge. However, managing water in the FRB also requires information about the particular water resources in the basin, the needs of its residents, the capabilities of its infrastructure, and the social and economic issues in the basin that affect water and sanitation. Although the DRFN has significant experience in supporting BMAs in the Kuiseb and Cuvelai-Etosha river basins and in Namibia generally, the foundation's researchers must be familiar with the particular facts-on-the-ground that could help them determine if a BMA could be implemented in the FRB. The various stakeholders in the basin have access to much of this knowledge, but it has not been collected and integrated into an overall picture of the basin that could inform decision-makers about the appropriateness of the BMA in the FRB.

Our goal was to assist the DRFN in assessing the potential for the implementation of the formation of a Basin Management Approach in the FRB by collecting and synthesizing basic but crucial information on water use, management systems, sanitation methods, cost recovery systems and perceptions about water and sanitation in the urban settlements of the FRB. For the purposes of this project, urban settlements in the FRB were considered to be any form of settled population with some form of local governance, including settlements, villages, towns, and municipalities.

To achieve our objectives, we interviewed public officials, bulk water providers, local authorities, and other experts, both in Windhoek and in the Fish River Basin, to obtain information about sources of water and types of sanitation in the urban settlements of the FRB; how much water is supplied, used, and unaccounted for; tariffs and other cost recovery systems; and water and sanitation management strategies already in place. We also learned of the perceptions of suppliers, authorities, and consumers about water management and

sanitation issues in the FRB. This report, for the DRFN and other decision-makers in Namibia, includes a summary of our findings, along with discussion, analysis and recommendations for the possible implementation of a water and sanitation management system on the basin level.

2 BACKGROUND

Initiating an investigation into sustainable development requires familiarity with a wide variety of factors. Among the factors that will influence any sustainable water management strategy in the Fish River Basin (FRB) are general theories of basin management, the economic and social policies of Namibia with respect to water and sanitation, the environmental characteristics of the FRB, and the social dynamics of its residents. According to Namibia's Water: A Decision Makers' Guide (Heyns, Montgomery, Pallett & Seely, 1998), sustainable development "meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (p 10a). Sustainable development therefore requires an understanding of the water and sanitation needs that now exist in the FRB, as well as a reasonable projection of those needs into the future. This section of our report discusses water management and sanitation from a global perspective as well as at the basin level, and introduces the environmental characteristics in the FRB.

2.1 BASIN MANAGEMENT APPROACH

The Basin Management Approach (BMA) is a community-based management system based on the decentralization of control to the local level (DRFN, 2005). A river basin (catchment, water basin, watershed, etc.) is the drainage area of a particular river and its tributaries, both above and below ground (Amakali & Shixwameni, 2003). The boundaries of a basin signify the boundaries of influence of stakeholders upon one another; the water use of any stakeholder within the basin has the potential to affect the water supply of others within the basin, especially those downstream. In light of this fact, basin management approaches are used to coordinate the water use of all stakeholders in a basin. Stakeholders may include individual users, local officials, technical experts, and companies that supply water in bulk to various users (The Namibia Water Corporation, NamWater, in the case of Namibia). Regardless of size, shape or political boundaries, a basin should be considered as one unit for water management to be most effective. Figure 1shows the boundaries of Namibia's 11 river basins.

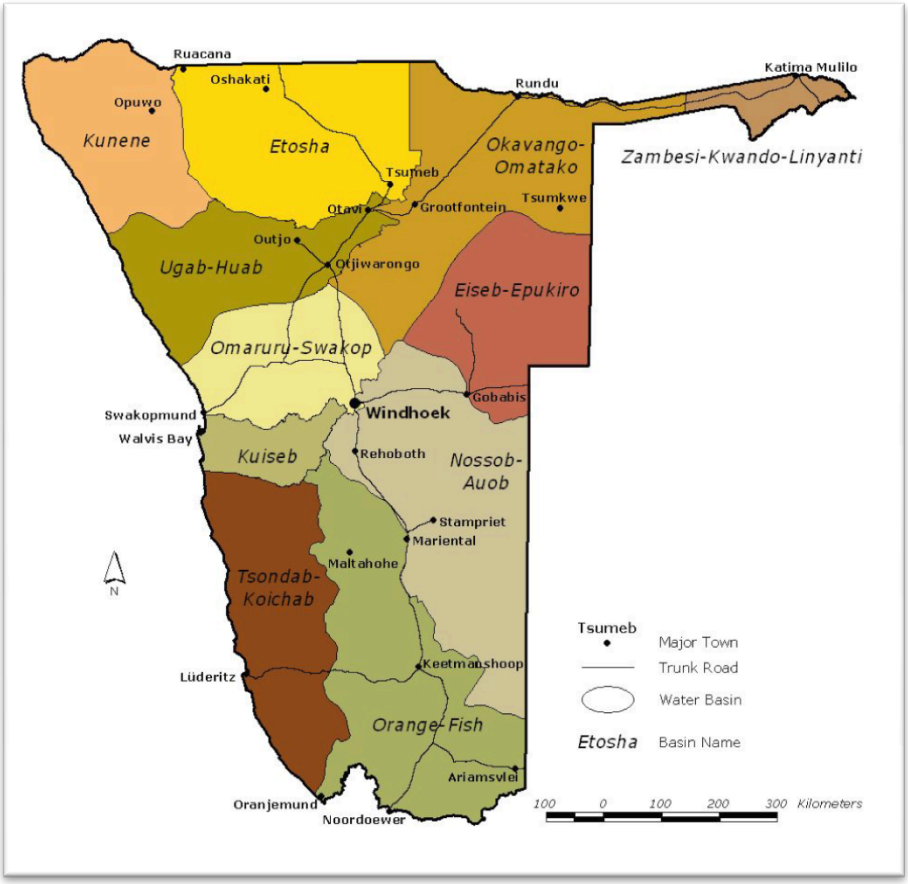

FIGURE 1: RIVER BASINS WITHIN NAMIBIA

Source: (DRFN, 2005)

2.1.1 BMA IMPLEMENTATION

The DRFN has identified three phases of a BMA: start-up, stakeholders' forum, and the formation of a basin management committee (BMC) (DRFN, 2005).Figure 2 illustrates the process for the formation of a BMC. In the start-up phase, an initial collection of data about stakeholders and basin characteristics is conducted. Because of the mutual influence of all stakeholders in a basin, this data collection should be a broad as possible, considering all factors that influence the shared water supply. During this phase, available water sources, such as rivers, reservoirs and groundwater along with the existing management systems are evaluated. In the next phase, the stakeholders' forum phase, stakeholders are brought together to share and compare knowledge about the basin and to form a consensus about the potential for a BMC. The final phase is the actual development and implementation of a basin management committee. Amakali, et al. (2003) suggest that committees be made up of twelve representatives including stakeholders, government officials with resource management experience, regional and local representatives, and others with environmental

interests (Amakali & Shixwameni, 2003). The committee acts as an advisor to oversee and plan for sustainable water management within the basin. BMC members must take into account how water management affects the basin's economy, society, and environment both directly and indirectly (Amakali & Shixwameni, 2003).

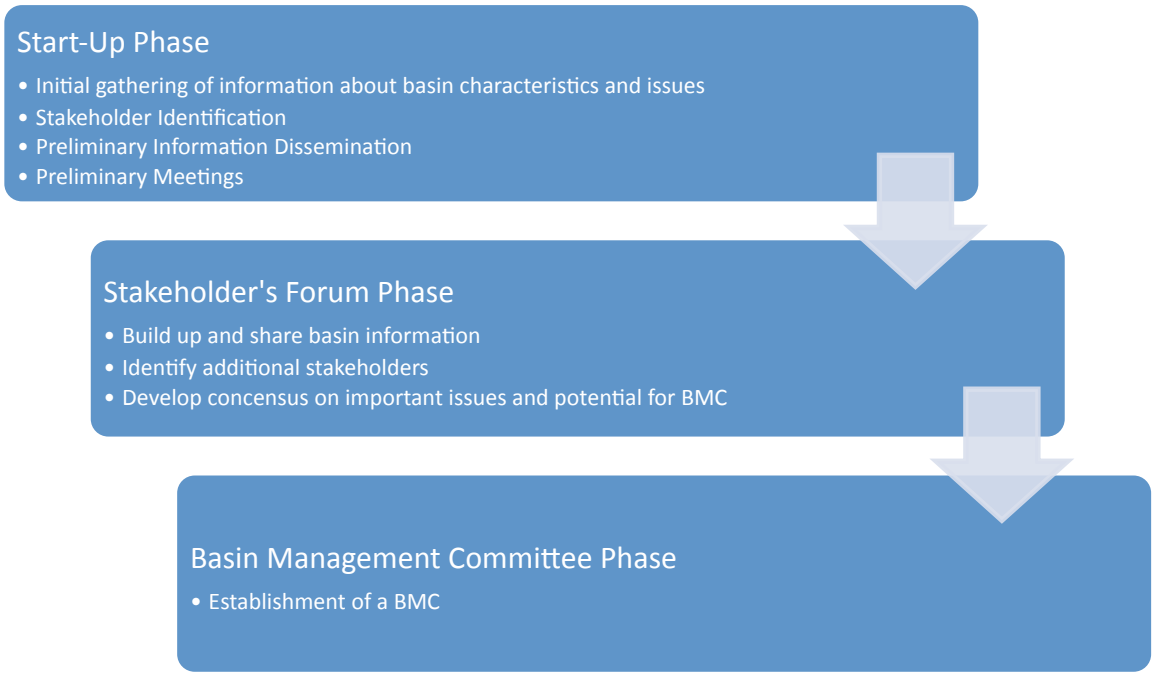

FIGURE 2: STAGES OF BMA IMPLEMENTATION

Source: adapted from Dragnich, Dungca, Pendleton, &Tracy, 2007

2.1.2 INTEGRATED WATER RESOURCE MANAGEMENT

Basin management systems rely on ideas stemming from Integrated Water Resource Management (IWRM). IWRM is a planning and implementation process that unites stakeholders to make decisions based on sustainability, environmental impacts, and economic benefits (USAID, 2006). The approach also looks to optimize the water supply and empower stakeholders to make decisions about their water supply by decentralizing power. The following case study from Kazakhstan is just one instance of IWRM being successfully implemented internationally.

Case Study: Importance of IWRM in Kazakhstan

The government of Kazakhstan worked to solve their nation's water crisis by implementing IWRM strategies (United Nations Development Programme, 2008). Kazakhstan has struggled for many years with distribution, inadequate water budgets, and a

low number of people involved in water management. The country is sparsely populated and has limited, seasonal water resources. Water problems are compounded by the fact that over 75% of the land is being used for agriculture, and the resulting high water usage in this sector makes desertification an issue. Residential water needs make up only about 5% of the total water use. With support from the United Nations Development Programme, the Global Water Partnership, and with the financial backing of Norway, the Kazakhstani government began to develop an IWRM scheme in 2004 to implement through their Committee for Water Resources. This was the first IWRM scheme to be used in Central Asia. Through discussion with stakeholders and other groups, the government chose to implement the new policy first in the Nura-Ishim Water Basin to test the effectiveness of the legislation. The first basin management council was difficult to form, though it was required by law. A challenge confronted in creating the committee was the hesitancy of stakeholders who did not understand the rationale of the program. However, the committee eventually became a successful model for other basins in the country. This demonstration project was important because it showed that the river basin was the appropriate unit to use when managing water resources. The project led to scientific analysis of water supplies in the region, which found the amount of accessible water as well as looked at the types of sanitation in use. Other issues addressed included overuse of irrigation water, increasing salinity of aquifers, and unmanaged waste disposal.

The initial project provided an example of the positive effects of utilizing IWRM and basin management strategies and introduced stakeholders and the government to more effective methods of water management. The improved governing policies have led to stronger water regulations, better-informed and more active stakeholders, and assistance from international expertise. This project took place over the course of eighteen months, after which the IWRM plan was modified and used to establish councils in eight other River Basins. These councils helped implement the policies and decentralize the Committee for Water Resources so that local stakeholders could have more control over their resources. The Committee for Water Resources planned to reach the MDGs for sanitation and water supply. The project faced some obstacles that were overcome through training and education of both water users and government agencies. For example, the Committee for Water Resources was slow to implement the IWRM strategies because they felt it was a duplication of their own work, but through dialogue the importance of the IWRM techniques was recognized. The reconfiguration of water management has helped to address water quality issues and riparian

relations. Currently, the government plans to implement the IWRM strategies in other basins.

2.1.3 THE BASIN MANAGEMENT APPROACH IN NAMIBIA

The basin management approach has already been successful in other areas of Namibia. The first such example is the Kuiseb River Bain, chosen for the first BMA project because of the water management challenges there. Specifically, tensions existed between upstream and downstream water users who felt that they were competing for the same water supply. The DRFN initiated the first stage of BMA implementation there. Research was conducted into the actual relationship between the two groups' water use, and a basin management framework was established through which such concerns could be discussed and resolved. As a result, tension among water users in the Kuiseb has been significantly decreased.

Case Study: Land Use and Society in the Kuiseb River Basin, Namibia

The Environmental Learning and Action in the Kuiseb (ELAK) project was carried out by the DRFN and sponsored by the European Union. The project goal was to establish a basin-wide management plan for the Kuiseb River ephemeral river basin in Namibia (Botes et al., 2003). The first stages of this project involved collecting perceptions on water quality and accessibility, and identifying other concerns of stakeholders. Water users at the upper part of the river engage in livestock farming, while the lower basin is put to more industrial, commercial and residential uses. The livestock farmers in the upper part of the basin collect water for their livestock through the use of small dams (of less than 20,000 m^3storage capacity) and boreholes. The dams contribute to local groundwater recharge, providing water to their boreholes. Tension had mounted between the livestock farmers in the upper part of the basin and the stakeholders that live in the lower part of the basin, because the population in the lower basin felt that they were receiving increasingly less water each year because of the farmers' dams. The population in the lower part of the basin relies on subsurface water resources that are recharged by the flow of the river, while upstream people rely on groundwater stores. A lack of communication between the two areas resulted in the stakeholders in the lower basin feeling that water was not being allocated properly.

The accusations by the lower basin towards the upper basin were nullified with a better understanding of the hydrology of the area. Research performed by U.S. students from the Worcester Polytechnic Institute found that the dams used by farmers upstream were not

significantly affecting the water supply downstream (Hicks, Johnson, Torilli, 2003). It was also found that rainfall has decreased in the upper basin during the last thirty years. In order to inform stakeholders of the facts, the authors developed a brochure that could be distributed to stakeholders and others interested in working towards basin management.

This project sought to discover reasons why stakeholders were dissatisfied with their current water access, as well as find evidence as to whether their dissatisfaction was well founded. The project compiled known information, viewpoints, and methods of management and then developed a system to educate the public about what was actually happening with the water. This helped to ease social tension and work towards stage two of implementing a management plan, and developing a common vision for the basin.

2.1.4 THE HISTORY OF BMA IN THE FISH RIVER BASIN

The DRFN began holding stakeholder forums in June 2005, when the first Fish River Basin stakeholder forum was held in the Hardap Region. At this first stakeholder forum, a common vision for the Fish River Basin was developed. The vision, based on discussions about what stakeholders wanted for the basin in the future, was "a healthy Fish River Basin to sustain the livelihoods of all current and future inhabitants, including the environment and livestock" (DRFN, 2007, 5). Since this time, stakeholder workshops have been held four additional times, once every six months and typically alternating in location between the Hardap and Karas Regions. The goal of these forums is "to establish a relationship between all organizations with an interest in and that are affected by the use and management of resources within the Fish River Basin, and promote an understanding and relationship between them" (DRFN, 2007, 6). During past stakeholder forums, there were many topics of discussion. First, an institutional analysis of all stakeholders within the Fish River Basin was conducted in order to gain a better picture of who should be involved if a basin management committee was created. In the beginning, the aim of the forums was to gain a better understanding of how a basin management committee should be created, who should be involved, and what the current situation in the basin is. Some ideas presented included the division of the basin into lower and upper regions, to make basin management and communication logistically easier, as well as the creation of a feedback channel between the project and the stakeholders. Concerns were raised about the water quality in the basin, especially groundwater quality because it is a major source in the basin, and the pollution of surface water with agro-chemicals used by irrigation farmers. These issues are currently

being explored and will hopefully be addressed in future stakeholder workshops. One such step was already taken through an educational presentation given by Dr. Martin Falke at the last stakeholder forum. The presentation specifically assisted by providing methods to prevent pollution.

Presentations about stakeholder forums have been made about management in other basins such as the Boteti in Botswana. The Boteti Basin is another basin under study through the ERB project that has implemented the Basin Management Approach and provides a good example for the FRB to follow. In addition to the Boteti, other basins within Namibia have used the same approach and provide insight into successful methods in the first steps of implementation.

In one session last November, the stakeholders were asked several questions about expectations from a BMC. In general, stakeholders believe a BMC should have committed members who will actively work towards effective basin management and that this type of platform, whereby everyone is informed of issues in the basin, will be beneficial. Some perceived benefits include providing leadership opportunities to people in the basin and improving the livelihoods of community members. All stakeholders present felt positive about the creation of a BMC.

Currently, the DRFN is facing some problems with its stakeholder forums, because active participation from NamWater, commercial farmers, government ministries, and the Regional Councils has yet to be realized. Sometimes, prior commitments and the unwillingness to devote two days to stakeholder forums are the cause of this lack of involvement. To solve this problem, the DRFN plans to hold individual meetings with each group to ascertain why attendance has been poor. Possible solutions include shortening the forum to one day or changing the arrival time for the first day to the afternoon. Internet conferences are also being considered, although this may be difficult because many of the stakeholders in the FRB lack the computer capability for such a forum.

The next stakeholder forum is scheduled for mid-June, 2008. During this forum, topics to be addressed include water quality and sustainability of water sources, cost recovery issues, and alternative means of sanitation. It will be held in the Hardap Region.

2.2 WATER AND SANITATION POLICY

While the physical environment is an important influence on resource management, policy decisions at all levels of government are also critical considerations in understanding

resource management. Policy on the international level guides cooperative efforts among nations, and, in the case of water management, there is currently significant international support. This is especially true among African nations. Policy and law in Namibia, responding both to the international agenda and its own interests with respect to water management, provide a theoretical and organizational foundation for water management endeavors in the country.

2.2.1 INTERNATIONAL

Water management is a major focus of the international community. The United Nations' Millennium Development Goals (MDG), drafted and enacted by the United Nations in concert with world development institutions such as the World Bank and the World Health Organization, include a goal to reduce the number of people without safe drinking water by half and to end unsustainable exploitation of water resources by 2015 (UN General Assembly, 2000). In 2002 at the UN World Summit on Sustainable Development in Johannesburg, the MDGs were amended to include the goals to develop IWRM plans by 2005 and to reduce by half the number of people in the world without access to basic sanitation in the following decade (United Nations, 2008). In 2003, the United Nations General Assembly declared the years 2005 through 2015 to be an international decade for action called "Water For Life" with the goal of promoting water-related efforts set out in the Millennium Development Goals in 2000 and 2002. Then, in 2006, the United Nations General Assembly declared 2008 an International Year of Sanitation in order to promote sanitation efforts set out in the 2002 Johannesburg Plan of Implementation.

The nations of Africa have allied in many ways to address water and sanitation issues. In 2001, the Organization for African Unity - now known as the African Union - created the New Partnership for African Development (NEPAD) as a framework for promoting socio-economic development in Africa (NEPAD, 2001). Water and sanitation are recognized as key priorities in this overall endeavor. Water is a high priority for the African Development Bank (ADB), as well, which promotes economic and social development through loans, equity investments, and technical assistance (ADB, 2008). The ADB also organized First Africa Water Week for March 2008. Both NEPAD and the ADB operate by coordinating efforts and sharing information among their member nations across the continent.

This vigorous level of support from the international community both enables and encourages organizations such as the DRFN to undertake water and sanitation projects. This

is particularly true for the DRFN's project in the Fish River Basin, which is part of a four-year, multinational effort being funded by the Norwegian Ministry of Foreign Affairs (Klintenberg, 2007).

2.2.2 NAMIBIA

As the first nation in the world to explicitly incorporate environmental protection into its constitution, Namibia has long recognized the importance of resource management for its socio-economic well-being:

> The State shall actively promote and maintain the welfare of the people by adopting … policies aimed at … the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future (CIEL, 2006, p.5).

This and similar provisions of Namibia's constitution are, in part, reactions to its pre-independence experiences. Before gaining independence in 1990, Namibia was occupied by South Africa, a nation that had itself long been the subject of European rule and influence. As a result, water laws and policies suitable for water-rich Europe were instituted in arid southern Africa (Ministry of Agriculture, Water and Rural Development, 2000, p7). In 1956, South Africa developed the South African Water Act, a pre-independence water management strategy (Schachtschneider, 2002). When it was first established, the Act stated that each stakeholder was responsible for the water on his land. In the Fish River Basin, this is unreasonable considering that most stakeholders do not have water from runoff and would therefore have no access to water during drier parts of the year.

Namibia's constitution provides the policy basis for the Water Supply and Sanitation Sectors Policy (WASP) guidelines adopted by the government in 1993 (Ministry of Agriculture, Water and Rural Development, 1993). Namibia's WASP guidelines include strong policy declarations that motivate efforts to improve water and sanitation throughout the country. Its four overall policy statements are (Heyns, Montgomery, Pallet & Seely, 1998):

- Essential water supply and sanitation services should become available to all Namibians, and should be accessible at a cost that is affordable to the country as a whole.

- This equitable improvement of services should be achieved by the combined efforts of the government and the beneficiaries, based on community involvement, and the acceptance of mutual responsibility.
- Communities should have the right, with due regard for environmental needs and the resources available, to determine which solutions and service levels are acceptable to them. Beneficiaries should contribute towards the cost of the services at increasing rates for standards of living exceeding the levels required for providing basic needs.
- Environmentally sustainable development and utilization of the water resources of the country should be pursued in addressing the various needs (p.30).

The WASP guidelines further call for Namibia's water policies to (Heyns, et al., 1998):

- Contribute toward improved public health
- Reduce the burden of collecting water
- Promote community-based social development especially taking into account the role of women
- Support basic needs
- Stimulate economic growth

And for Namibia's sanitation policies to:

- Contribute towards improved health
- Ensure a hygienic environment
- Protect water sources from pollution
- Promote conservation of water
- Stimulate economic development (p.32)

Decentralization also plays an important role in water and sanitation policy in Namibia. The WASP guidelines call for "the maximum involvement of the users" in policy implementation and "the delegation of responsibility to the lowest possible level" of government (Ministry of Agriculture, Water and Rural Development, 1993, p. 18). Decentralization is embraced primarily as a means of fostering motivation and commitment among Namibians to help implement policy measures, and it is seen as such an important principle in Namibia's resource management efforts, that WASP guidelines call for it to "take precedence over . . . performance" in the short term (p.32). Namibia's commitment to decentralization motivates its participation in projects like the Ephemeral River Basin (ERB-SADC) Project.

An important part of Namibia's decentralization efforts is Namibia's Community Based Natural Resource Management (CBNRM) program (MET, 2008). CBNRM requires devolving the management of the nation's natural resources to local communities who can effectively manage and benefit from their local environment. Rather than centrally managing Namibia's various and fragile natural resources, the Ministry of Environment and Tourism (MET) instead works in concert with NGOs such as the Namibia Nature Foundation and the World Wildlife Fund to promote and support local management programs. The community-based basin management approach being explored in the basins under the ERB project is a prime example of such a management program.

A more recent piece of water policy legislation is Namibia's Water Resource Management Act of 2004 (WRMA). The WRMA reiterates many of the broad principles in the WASP Act, including "equitable access to water resources by every citizen," and "harmonizing of human needs with those of the environmental ecosystems and the species that depend upon them" (Republic of Namibia, 2004, p9). However, the WRMA also includes explicit provision for basin management in Namibia. Section IV of the WRMA describes the establishment and function of BMCs. Among the functions of basin committees set forth in the Act are (p15):

- To promote community participation in the protection, use, development, conservation, management and control of water resources in its water management area through education and other appropriate activities;
- To promote community self-reliance, including the recovery of costs for the operation and maintenance of waterworks;
- To collect, manage and share such data as are necessary to properly manage the basin; and
- To help resolve conflicts relating to water resources in its water management area.

The Minister of Agriculture, Water, and Forestry may establish BMCs on that minister's own initiative or at the request of communities in a basin. Established BMCs are to be represented in a Water Advisory Council, which also includes members from each regional council, water management institutions, and community organizations. The Water Advisory Council works directly with the Minister to advise on water issues.

Although many of its provisions have yet to be implemented, the WRMA represents an important policy commitment to basin management, and the prescribed functions of basin

committees are in line with the Basin Management Approach as described in Section 2.1 of this report.

2.3 CLASSIFICATION OF URBAN AREAS

As our research concerns the urban areas the FRB, it is important to understand how such areas differ in size, capacity, and responsibility. Urban areas in Namibia are classified into several types: settlements, villages, mining towns, towns, and municipalities. Settlements are not informal settlements within townships, but urban areas that are generally smaller in population than villages and are managed directly by the Regional Council. The Regional Council employs a Settlement Officer in each Settlement Office to oversee the day-to-day management of the area. Towns, villages, and municipalities are autonomous local authorities of increasing size and economic capacity. Municipalities are further classified as Part 1 or Part 2, Part 1 being the most developed and autonomous local authority recognized in Namibia. The capital city of Windhoek is a Part 1 Municipality.

TABLE 1: URBAN AREA CLASSIFICATION ON THE FRB (STATUS: 2001)

Classification	Name	Region	Population
Settlement	Klein Aub	Hardap	300
Settlement (not declared)	Schlip	Hardap	776
Settlement (not declared)	Grünau	Karas	379
Settlement (not declared)	Ariamsvlei	Karas	428
Settlement (not declared)	Warmbad	Karas	162
Settlement (declared, not proclaimed)	Noordoewer	Karas	1,085
Village	Kalkrand	Hardap	1,038
Village	Maltahöhe	Hardap	1,663
Village	Gibeon	Hardap	2,537
Village	Tses	Karas	904
Village	Berseba	Karas	533
Village	Bethanie	Karas	1,017
Mining Town (to be declared as town)	Oranjemund	Karas	3,586
Mining Town (to be declared as town)	Rosh Pinah	Karas	1,537
Municipality Part 2	Mariental	Hardap	9,172
Municipality Part 2	Keetmanshoop	Karas	14,842
Municipality Part 2	Karasburg	Karas	3,996

Source: Dekock, Johan, personal communication, (April 10, 2008).

To change classification, an area must declare itself a village, town, or municipality to the Ministry of Regional and Local Government, Housing and Rural Development. Once approved, the Ministry will proclaim it as such. Each local authority has a Chief Executive Officer who is the chairman of the local Council, which is comprised of several elected

councilors who work on local issues. There are two mining towns in the FRB and each has a pending request to be declared as a town.

2.4 WATER DISTRIBUTION AND COST RECOVERY

Water availability and quality are important for many purposes, including the provision of proper hygiene and sanitation to Namibia's residents. Inefficient water management, treatment, or distribution, can result in outbreaks of waterborne diseases caused by inadequate waste treatment, poorly maintained sanitation facilities, and end-users turning in desperation to unpurified water sources. Essential to the infrastructure of water distribution and sanitation is some form of cost recovery, whereby those systems can be maintained and improved.

2.4.1 WATER DISTRIBUTION IN NAMIBIA

NamWater is the bulk water supplier throughout Namibia, responsible for supplying water directly from sources (i.e. rivers or boreholes), to users. NamWater was created by the government in 1997 to undertake this task (World Investment News, 2006). As a bulk water supplier, NamWater deals with municipalities, industry, agriculture, and local authorities rather than with individual consumers. In the Fish River Basin, surface water is collected behind three dams. These dams are: the Hardap Dam, located just outside of Mariental, the Naute Dam, near Keetmanshoop, and the Dreihuk Dam, down south near Karasburg. To collect ground water, boreholes are drilled deep into the ground to access water in aquifers. To reach the water, boreholes are sometimes drilled up to 400 meters into the earth. From the point where water is accessed, infrastructure (usually pipelines) is put in place to transfer the water from the source to a NamWater purification plant. The process of purification consists of the following steps: "Flash mixing (pre chlorination), radial flow sedimentation, contact reservoir (intermediate chlorination), filtration, storage (post chlorination) and distribution" (NamWater, 2008a, p. 1).

Water treatment starts at the flash mixer where flocculent and chlorine are added to the water. Chlorine kills any bacteria present in the water and flocculent binds with clay particles to separate them from the water in the clarifier (NamWater, 2008a). In the clarifier, the "floc" (combination of clay particles and flocculent) sinks to the bottom, while the clean water overflows into a channel to start the filtration. Here, sand filters are used to remove any remaining small particles and the water is finally collected in a well beneath the sand

filters (NamWater, 2008a). In the well, water again is treated with chlorine before being sent to reservoirs for storage.

At the NamWater plant, water also goes through a series of tests to ensure that it is safe for human consumption. One such test, conducted every two hours, evaluates chlorine levels in the water to make sure the level is sufficient but not excessive. In addition to this test, quarterly tests are performed on the chemical, bacterial, and mineral content of the water. From the plant, water is carried through pipelines to a main reservoir where it is stored before delivery to local authorities. At local authority delivery points, meters take readings of the amount of water supplied for both billing and record keeping purposes.

After this point, the local authority has its own infrastructure to supply its community members. In the Fish River Basin, the two main systems used are individual taps and standpipes. Individual taps are different from standpipes because they are only used by one household and are not communal. Also, individual taps are typically located inside households, while standpipes are centrally located outside for easy access to a number of households

Individual taps and standpipes use two different types of metering systems in order to measure the amount of water supplied by each to the user. The prepay system, is one in which users must first purchase a token from the local authority office with a certain amount of money on it. With this token, community members may access an amount of water, which equates to that which they have already paid for. When the token is inserted into the prepay meter, the balance is transferred into the meter's computer and will remain until the balance is depleted. The other metering system is termed conventional meters, which are simply mechanical meters which measure the amount of water which is supplied by the tap or standpipe to the user. With this information, the local authority calculates the individual's water bill at the end of the month. More often, prepaid meters are used on standpipes, as it is much easier to ensure that all users are paying and that the amount of water used is allocated correctly. Individual taps may use either metering system, depending on their location, and sometimes vary depending on the user's or local authority's preference.

Figure 3 illustrates the overall structure of Namibia's water distribution system.

Sources of Water in the Fish River Basin: Boreholes and Dams

Water is transferred from sources to NamWater treatment plants. Here, water goes through an extensive purification process and is tested for quality.

The first step in the purification process is chlorination. During this step, chlorine is added to the water to kill off any bacteria.

Flocculant is then added to the water, which helps clump together clay particles for easy removal. In the clarifier, these particles fall to the bottom as

The last step in the purification process is filtration. During this step, water seeps through sand filters to eliminate any other impurities. Water then collects in a Clearwater well, and chlorine is added once more.

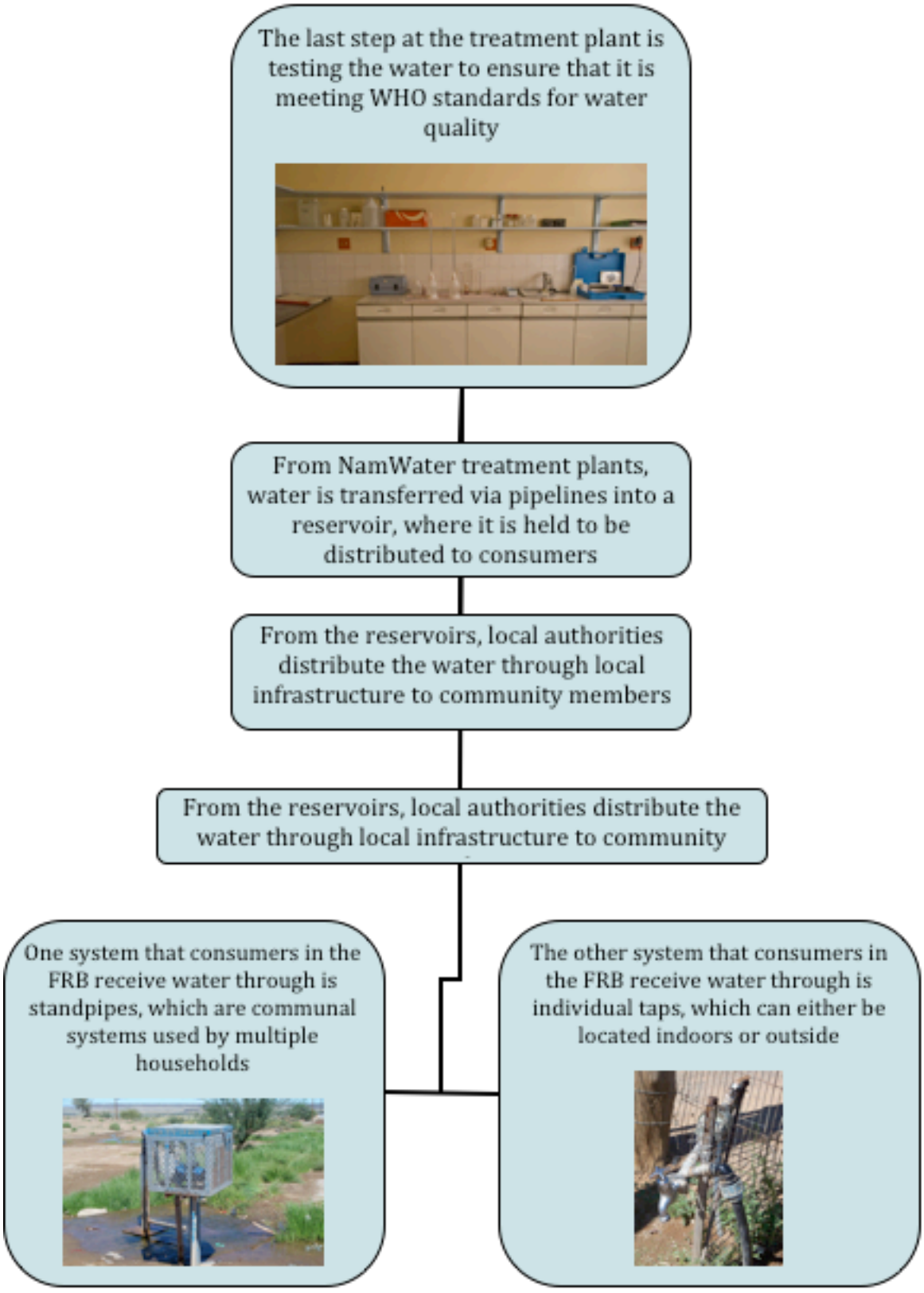

FIGURE 3: WATER DISTRIBUTION IN THE FRB

2.4.2 COST RECOVERY

Recovering the cost of delivering water and sanitation services is a challenge for governments throughout the world. Major methods of economic support are utilized to sustain service delivery systems. These are taxes, whereby the cost of delivering services is distributed among taxpayers, and user charges, which vary among consumers according to their use of services (Foster &Yaps, 2006). In both developed and developing countries problems are faced with recovering the costs of water systems and services (IRC, 2008). For example, of eighteen major cities studied in Asia, only half of these were able to recover the full cost associated with operation and maintenance of their water infrastructure (ADB, 2004).

Cost recovery is especially problematic in the context of low-income or impoverished consumers. Services should be made available to all, but cost recovery programs must strike a balance between accommodating those with little money and remaining financially sustainable (Foster &Yaps, 2006). One user charge system used in developing countries to address the issues presented by low-income consumers is the increasing block tariff system (Maloumby, 2007). Under this system, users are charged varying rates for a service depending upon how much of the service they use. In the case of water, for instance, users may be charged a base rate for water when their monthly use is below a certain threshold amount. Users who use more than this amount are charged at a higher rate. There may be any number of water use levels with accompanying rates. This system is often used for pricing other utilities such as electricity, but in Windhoek it is used for water services. In Windhoek, the first 6 cubic meters of water is provided at a subsidized rate, 6 to 36 cubic meters is priced at a full cost recovery level, and water use greater than 36 cubic meters is priced at an increasing rate (Maloumby, 2007). This cross-subsidization scheme allows low-income users to be charged below the cost of water delivery while still maintaining fiscal sustainability. A problem with the increasing block tariff system is that it assumes a correlation between service use and household income (Foster &Yaps, 2006). While this may be true for some services like electricity use, it is not always the case for services such as water.

One way of assessing the value of these programs is the Coady Statistic (Foster &Yaps, 2006), which assigns a numerical value to social programs based upon how well they target those in need. A value of 1 is assigned when a social program targets resources randomly across a population with no meaningful bias towards those in need. A value of

1.25 indicates that 25% more resources are successfully distributed to those in need than would happen with a purely random distribution. A value of 1.5 or greater is the generally acknowledged target for social programs, indicating that 50% more social resources are distributed to those in need than would happen through random distribution. The following case study describes a cost recovery program in Chile for which the Coady Statistic has been determined to be a value greater than 1.5.

Case Study: Effective Cost Recovery in Chile

In 1990,officials in Chile determined that the water tariffs must be doubled in order for their goal of full cost-recovery to be realized. Simultaneously, the Chilean government initiated a program to directly subsidize the poor to protect them from the increasing tariffs. Specifically, the program is to ensure that households do not spend greater than five percent of their income on water utility costs (Foster &Yaps, 2006). Subsidies are limited to the first 15 m^3. Eligibility for subsidy is reassessed every three years and is based on different poverty indicators, including household interviews. Because Chile has numerous other social welfare programs that determine eligibility through similar criteria, the administrative cost of this new project is reduced and distributed among those programs. The program benefits twenty percent of the Chilean population, which is approximately 600,000 people, and costs US$40 million per year.

2.4.3 COST RECOVERY IN NAMIBIA: NAMWATER

Although it is a seemingly more abstract aspect of water distribution, cost recovery presents a challenge with important tangible effects on water availability and quality for Namibians. NamWater collects, treats, and distributes water to these buyers, charging for the cost associated with handling the water but not for the water itself. This is in line with Namibia's policy that water be a free resource rather than an economic commodity (Dentlinger, 2004). Nearly all of the water used by Namibians is supplied by NamWater in bulk to municipalities and other organizations who in turn distribute it to end users (World Investment News, 2006). There are two levels at which cost recovery must occur: between NamWater and its customers, and between those customers and end users. NamWater's policy is to ensure that all projects achieve full cost recovery within five years, but this has not always been possible.

Cost recovery problems between NamWater and its customers have caused severe water shortages in the past. In 2004, NamWater was owed over N$63 million by its

customers (Dentlinger, 2004). More than half of this debt was owed by the town councils. Many people called for the government to reassume control over NamWater's responsibilities, but NamWater officials pointed out that a change in administration would not eliminate the costs of water distribution. Through government subsidization or improvements in town council fiscal behavior, these costs must be paid if bulk water distribution is to remain a viable service. In 2007, the government was forced to order NamWater to reopen rural water points that had been turned off for non-payment (Shigwedha, 2008). Communities were still expected to pay for their water, however. A basin management plan for the Fish River Basin would involve a coordinated relationship with NamWater designed to deal directly with these and other problems.

2.4.4 PERCEPTIONS ON WATER PAYMENT IN THE FRB

In order to gain an understanding of cost recovery issues that may exist in the FRB, it is necessary to look into the reasons for the non-payment problems that exist in other places. The NAWAC report written in 2005 serves as the basis for the information in this section. According the Namibian Water and Sanitation Policy, the minimum requirements for water supplied to households are as follows: the water supply must not be located at a distance of more than 2.5 kilometers away, people who rely on the source must be granted access to a daily supply of at least 15 liters per day per person (which can be adjusted to suit people's needs regionally), and it must not take longer than a half hour for the source to supply this amount. These requirements have been met in all areas of the Fish River Basin. Also, many people in Southern Namibia live very close to their water supply if they do not have water piped directly into their houses (NAWAC, 2005). Therefore, there must be other reasons why people are not paying for their water.

One plausible reason for why consumers in the Fish River Basin are not paying for their water may be that they feel as though they are being overcharged, and that the water bill is simply too high. As many residents in the FRB are either unemployed or pensioners, income is very low, and even low water bills may be difficult or impossible to pay. In the case of the Karas Region, the water quality received in the region was rated as poor when interviews were conducted (NAWAC, 2005). The amount of water used in the region is very minimal, as is true in the Hardap Region. Many do not understand the way they are charged with water and are unable to correctly estimate the amount that they use. Therefore perceptions that water bills are too high may be misconstrued. In the urban and rural areas of

the Hardap Region, where pipe bursts are a common problem, those interviewed complained about the lack of maintenance being performed on the pipeline. Pipes between the water point and the water meter are typically the consumer's responsibility for maintaining, but many do not have the technical skills or tools to enable them to do so (NAWAC, 2005). This is another problem, as error in meter readings could also result in a higher water bill, resulting in consumers paying for water they never see.

Although prepaid meters are relatively expensive for both those who must put them up and those who use them, the NAWAC study reports that most users in the Hardap region prefer this system and would rather use a prepaid meter that was more expensive than deal with the debt that results from conventional metering. They also believed that prepaid meters would reduce or even eliminate vandalism and unauthorized use of water pumps. Also, users believed this to be a fairer option because they would be ensured that they were only paying for the water that they used. Those in the Karas Region however, favored the current system. Asked what sources of water they preferred, they said they preferred boreholes, because they felt as though they were less expensive. In the Hardap Region opinion was divided. Some liked the idea of prepay meters, while others worried that the new meters would not be as reliable as conventional ones (NAWAC, 2005).

In the Hardap Region, aside from the water quality and maintenance problems, the main issue with non-payment, as stated in the NAWAC report, was that many people were simply unable to afford to pay their bill. Most in this region are either pensioners or have other expenses that they feel are more important. Prepaid meters are being called for in this region, because it is believed that this will oblige users to be more responsible and efficient in their water use. Many people in this region resent the government for not coming to their aid. People believe that they are not as well off as those in the North and should therefore receive some form of government aid. It is a very difficult situation because they have no alternate means of income, the soil is bad so they cannot support themselves through farming, and the economy is cash based.

The Karas region is much better off, not financially, but in terms of effectively paying for water. Out of those interviewed, none of them were in debt with NamWater (as of 2005), and although there are some issues with maintenance and quality, everyone seems to understand how much they owe and why they are responsible for paying. Both the Karas and Hardap regions are similar in that those interviewed in the regions seemed to be willing to pay for water services, and some even understood the importance of cost recovery to NamWater. As some stated, because of the treatment of the water and maintenance of the

dams and pipelines, it is only fair that they pay for the services provided by NamWater. However, as noted previously, the Hardap region struggles to pay because of the poverty there.

As water sources are very scarce in the South, both the Karas and Hardap regions have begun to implement measures to conserve water. In Hardap, children under the age of 8 are not allowed to collect water from water points, and this has reduced wasted water to 1.5 m^3 per month (NAWAC, 2005). They would also like to see more maintenance, as leakages in the pipes are common, though they do not have the resources to take care of these problems themselves. In certain urban areas of the Karas region, water pumps only operate during certain times of the day, which has proven to be an effective measure both for water conservation, as well as saving on the cost of diesel used to operate the pumps.

In the Karas Region in 2005, there were no glaring problems. People were paying for their water and had a good understanding of why it is necessary to pay for NamWater's services. However, in the Hardap Region, something needs to be done to remedy the situation of pipe bursts. Also, something needs to be done to assist the people in the region with paying for their water. Poverty in the region is a major issue, and subsidies or lower tariffs must be established if there is to be progress made in this area.

The following case study provides a powerful example of how cost recovery was improved in one Namibian town.

Case Study: Effective Cost Recovery in Rehoboth, Namibia

An important case study of cost recovery in Namibia is the work done by Africon and Environmental Engineering Services with the Municipality of Rehoboth during the years of 2002 through 2004. The previous cost recovery system in Rehoboth was ineffective, resulting in a debt to NamWater of N$7 million in 2001 (Feris, O'Flaherty, van der Merwe, 2005). An initial assessment of the situation in Rehoboth identified five main issues that would be addressed:

- There were many administrative problems related to the fundamental tasks of reading meters and processing user accounts.
- Infrastructure, including water meters, was being maintained poorly or not at all.
- The tariff system placed undue burden on residential users, especially those with low income.
- A disorganized system of issuing credit to customers was resulting in only 50% to 65% of monthly bills being paid.

- The Town Council, which manages water within Rehoboth, had no effective way of communicating with users.

These problems were identified with the help of community members, whose input reflected the concerns of the wider community with respect to water distribution in Rehoboth. Once these problems were identified, remedial actions were designed to address them.

Measures were taken to increase rationality and equitability of tariffs and money collection. A Tariff Advisory Committee was established, consisting of community members and council officials who developed a more equitable tariff scheme for the town. Because of the high capital and maintenance costs associated with water distribution, even the base-level tariffs were very high. The new tariff scheme implemented cross-subsidization within the community, shifting some of these costs to higher-volume users. In addition, extremely light users of water (<15 m^3/month) were given a rebate up to N$31.50, which significantly lowered the water bill for the poorest residents. A new system was also developed to deal with the large amount of user debt that had accrued. This system instituted many different measures towards the payment of this debt: In addition to paying their current water bill (which, under the new tariff scheme, was often lower in the case of users with outstanding debt), users were obliged to make minimum debt repayments. Important to note here is that the Town Council could have simply raised these users' water tariffs in order to pay for their debt, but by making the debt repayment transparent and by working with users to establish a minimum payment that they could afford, the council received a high degree of cooperation from users.

Measures were also taken to improve infrastructure maintenance in Rehoboth in order to reduce the amount of water lost in the system. Officials received training to help them identify leakage problems, and members of the community were deputized to do preventative and remedial maintenance on municipal and private systems. Water purchased from NamWater and lost to leakage must still be paid for, either by the municipality as a whole through higher tariffs or through higher monthly bills to individuals whose systems are leaking water. A reduction in leakage therefore lowers the cost of water and thereby enhances cost recovery.

An especially important aspect of the Rehoboth water system addressed by the project was that of communication between the Town Council and water users. This issue was addressed in multiple ways. A customer care office was created to function as a resource for water users and to provide an administrative center for the Town Council's efforts to

communicate with users. Employees at the Town Council entered a customer communication and awareness program. Additionally, a quarterly newsletter was distributed to water users to inform them of new changes and to educate them about effective water use. Users who did not pay their bills on time now received notification not only of their tardiness, but also of the late fee that would appear on the next bill.

The results achieved through these measures were extremely positive. By involving community members in decision-making, and by making tariffs and debt repayment more sensitive to low-income users, the Town Council received payment from many more users than before. Because of this, by the second year of the project, water revenue was nearly N$2 million more than the total amount billed to users for water services. Over N$3.5 mullion of debt to NamWater was paid as of March 2004. Also, the amount of water bought by Rehoboth dropped by 500,000m^3 per year, and a larger percentage of purchased water was sold to and paid for by users.

The Rehoboth project demonstrates that a wide variety of factors are relevant to cost recovery. The project's success derived from its simultaneous confrontation of issues related to infrastructure, technical training, communication and customer care, equitability, and community involvement. The collective effect of measures addressing all of these issues is far greater than the sum of each measure's individual effectiveness.

The project further demonstrates that cost recovery is not an issue that can be addressed independently of social and political factors. Whereas some aspects of water management have purely technical or administrative solutions, effective cost recovery systems depend upon effective people-based measures. To quote the final project summary: "The dedication, team effort and positive attitude by the Rehoboth Town Council and officials [and] the active participation of local community during the implementation of the project [were] the most important reason for the positive results that were achieved." (p.1). Since the completion of the project, some of the key supporters have left their positions, and cost-recovery is no longer as successful as it was at that time. This demonstrates the importance of institutional memory in cost recovery programs, but also the great difference that enthusiastic people can make.

The example of Rehoboth provides a useful standard for evaluating cost recovery programs in the FRB.

2.5 ENVIRONMENT

Namibia's arid climate and geography contribute significantly to the country's scarcity of water. As a result, freshwater sources are scarce, and the successful implementation of a sustainable water management plan is a necessity. This section provides an overview of the climate and geography of Namibia, their impact on the water shortage, and how these factors play into the bigger picture of water resource management.

2.5.1 CLIMATE

One of the major challenges of implementing a water management plan in Namibia is the country's climate and geography. "Over much of the country and for most of the year, the climate [of Namibia] is best described by one word: arid" (Mendelsohn, Jarvis, Roberts, & Robertson, 2003, p.8). Namibia lies between two contrasting climate systems, the Intertropical Convergence Zone, from which moist air is fed into the country from the North, and the Subtropical High Pressure Zone, which feeds in dry air and negates the presence of moist air from the North (Mendelsohn, et al., 2003). As a result, this dry atmosphere dominates in Namibia, resulting in high temperatures, clear skies, extreme sun radiation, and high evaporation rates. Also, these systems play a factor in the amount of rain that falls in Namibia.

Overall rainfall rates in Namibia are low compared to that in other sub-Saharan African nations, varying from 0-50 mm annually in the southwestern portions of the country, to 700 mm in the Caprivi Region in the Northeast, as depicted in Figure 1 below. (CIA World Factbook, 2007). The rainy season in Namibia typically occurs between the months of December and April, and during the rest of the year, there is very little rainfall, except in the Southwestern areas of the country, including the southern areas of the Fish River Basin. The Fish River Basin, located in the arid south, receives very little rainfall annually, averaging around 250 mm per annum in the areas of the basin, which receive the highest rainfall. From year to year the rainfall amounts also vary, with floods in some years and droughts in others. This makes planning extremely difficult and water management a crucial issue for the country.

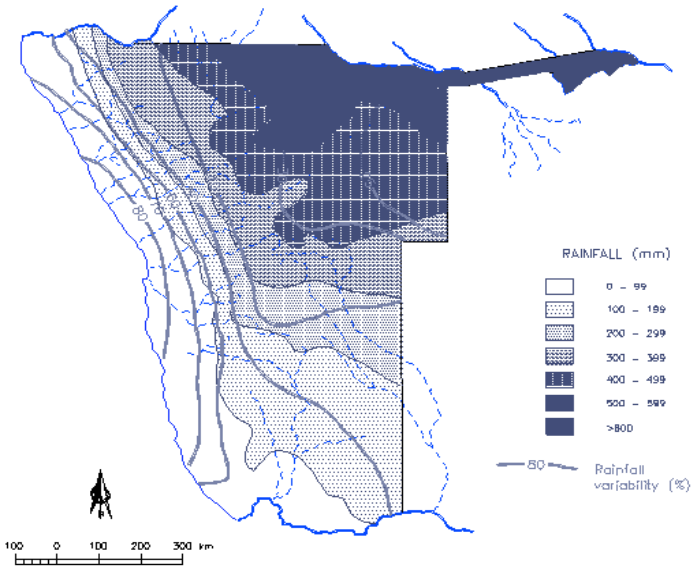

FIGURE 4: MEAN ANNUAL RAINFALL AND RAINFALL VARIABILITY IN NAMIBIA

Source: (Wardell-Johnson, 2000)

Another factor that makes conserving water unusually difficult for the people of Namibia is the high evaporation rate. High average temperatures combined with 300 days of clear skies annually result in the rapid disappearance of surface water. Often, especially in the southern portions of the country, there is a water deficit. A "water deficit" occurs when the rate of evaporation exceeds the amount of rainfall. In Namibia, "the potential for loss of water through evaporation far exceeds the amount of water that might be gained through rainfall" (Ephemeral, 2006, p.10). The graph below (Figure 5) depicts a comparison of the rainfall rate versus the evaporation rate in Ondangwa (located in the North). Even here, where rainfall rates are the highest of any region in the country (with the exception of Caprivi), the evaporation rate is significantly larger than the rainfall rate during almost every month of the year.

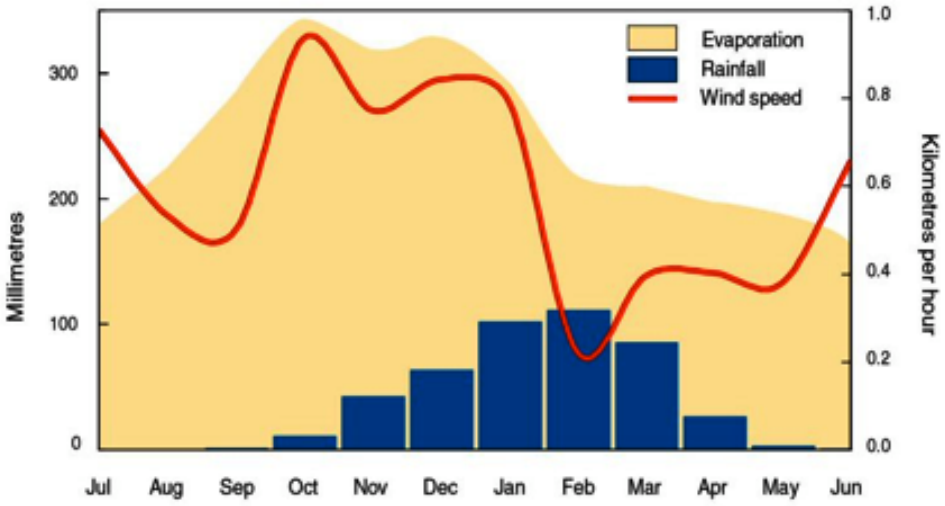

FIGURE 5: RAINFALL VS. EVAPORATION VS. WIND SPEED IN NAMIBIA

Source: (MET, 2007)

The combination of low rainfall rates and high evaporation rates commonly results in long periods of drought, which is a major problem in the Fish River Basin. The establishment of a sustainable and efficient water management plan, although difficult because of these reasons, is of the utmost importance.

2.5.2 SOURCES OF WATER

It is hard to find surface water anywhere in Namibia. The meager amount of rain that does fall immediately disappears, either through evaporation, by seeping into the ground, or by rapidly draining into an ephemeral river (Mendelsohn et al., 2003). With the exception of the perennial rivers on the borders of the country - Orange in the south and Kunene, Okavango and Zambezi in the north - there are only ephemeral rivers in Namibia, which flow periodically during the rainy season after good rains. The Fish River, an ephemeral river, holds water for a small portion of the year. These ephemeral rivers account for nearly a quarter (23%) of Namibia's total sources of water (MWLTC, 1994). As a result of the temporary supply of water on the surface of the riverbed, there is a strong dependency upon underground sources of water, especially aquifers, in these river basins. Aquifers and other underground sources are the most common water sources for the nation, supplying 57% of the water.

While some of these aquifers are located relatively close to the surface and are easy to access, through hand-dug wells, others are far more difficult to reach. These other aquifers can be located up to 100 meters or more below the surface, and require drilling in order to

gain access to them (Mendelsohn et al., 2002). Another problem that exists with these sources of water is that often there is a high concentration of salt or other chemicals in the water, which make it unfit for drinking. There are two types of aquifers, fractured, which are found in hard rocks where the water seeps through the cracks, or porous, which "occur in sandy areas, where the water percolates through the sand" (Mendelsohn et al., 2002, p.65). Figure 6 depicts a map of Namibia with regions shaded to show which types of aquifers are located in different regions of the country. Most often these aquifers gather their water from the surface; however, the water has the ability to flow laterally underground, so in some cases these aquifers can be replenished by water that fell in a location distant from where the aquifer is. In the FRB, although both porous and fractured aquifers are present, fractured aquifers are more commonly used as a water source.

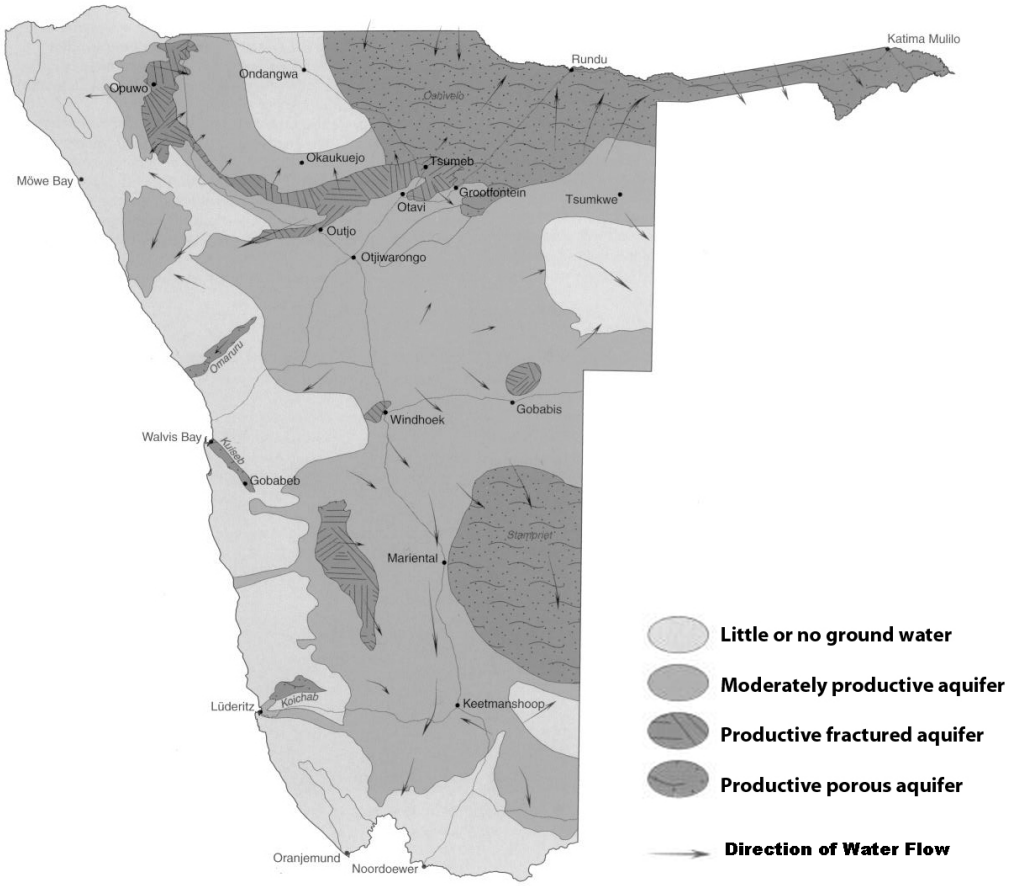

FIGURE 6: TYPES OF AQUIFERS AND THEIR OVERALL PRODUCTIVITY

Source: (Mendelsohn et al., 2002, p. 65)

Although quite common throughout Namibia, these sources of water (aquifers and ephemeral rivers) cannot be depended upon. Two major sources of water, the Cuvelai-Etosha region in the north and the Orange River basin, into which the Fish River flows, cross or form

an international border, compounding management issues with political issues. A significant percentage of the population of Namibia relies on water sources that can be affected not only by climate but also by foreign policy. Although international relations are currently stable between Namibia and South Africa, Angola, Botswana and Zambia, problems between the countries could easily result in further water management and scarcity issues.

2.6 KARAS & HARDAP REGIONS

The Fish River Basin lies within two governmental regions: Karas and Hardap. The Karas Region is the southern area of Namibia, bordering South Africa and is home to about 69,300 people. The Hardap Region, directly north of the Karas Region, is home to 68,249 Namibians (DRFN, 2007b, 2001 Population and Housing Census 2004). Neither region is entirely in the basin, so generalizations are difficult to make on the basin alone. However, both regions speak mainly Afrikaans (the lingua franca) and Nama as the first language. Oshiwambo is another popular language in the FRB, and the population speaking English extremely low.

The distribution of wealth and land ownership varies greatly in southern Namibia. Many in the basin, over 26% of both regions, are considered poor, and just fewer than 5% in each region are extremely poor. Extreme poverty is defined as those who spend more than 80% of their income on food, while poverty is defined as those who spend more than 60% of the household expenditure on food. In the basin, close to the Fish River, large-scale irrigated farms are present near the Hardap and Naute Dams in Mariental and Karasburg, respectively. State protected land, freehold farmland and government issued communal farmland are also present in the basin. In general, white Afrikaans-speakers own land while the Nama-speakers work as laborers on farms, mines and in industry. Nama speakers are generally less wealthy than Afrikaans speakers.

2.7 SANITATION

Water issues cannot be understood without a close look at sanitation. Many sanitation methods are dependent upon an adequate supply of water, and human waste has the potential to contaminate ground and surface water when sanitation methods are inadequate or improperly used. We will now discuss some various sanitation methods that are available.

2.7.1 AVAILABLE SANITATION METHODS

In this section, we will review the sanitation methods that are available in Namibia. Some of them are unlikely to be found in the FRB during our research, but the methods that we do find to be in use should be evaluated in light of the range of methods that are available.

Conventional sewerage is the most common sanitation method used in developed countries (Wienecke, Mawisa, 2007). It was developed in water-rich countries but has now been adopted around the world as a standard method. The appropriateness of this method for arid southern Africa is arguable given its dependence on a large, steady supply of water to transport waste. Although the technology and expertise needed to implement this common system is widely available, conventional sewer systems require pump stations, treatment facilities, and manholes that are expensive to construct, especially in Namibia where large, flat areas can only be serviced by sewerage systems that run up to ten meters below ground. Waterborne sewage can be treated very effectively through chlorination and other established methods. Some user education is necessary to ensure that improper materials are not flushed into the system.

Vacuum sewerage systems are a relatively new technology that is only in limited use in Namibia. Vacuum systems are very similar to conventional sewerage systems in form, but are quite different in terms of construction and operation. Vacuum stations generate suction within the infrastructure, which allows waste to be transported with less water (about one liter per flush, if specialized toilets are used). Vacuum systems are also quicker and cheaper to construct. Pipes can be placed in narrow trenches as near as one meter to the surface, so deep excavation is not required, even in flat areas. Vacuum system pipes can also be laid around obstacles or among irregularly arranged usage points, and fewer vacuum stations are required than pump stations for a conventional sewerage system. The system does require energy to maintain negative pressure within the system, and much of the vacuum system technology must be imported.

A **Septic Tank** is a large, underground tank surrounded by a leaching field. They can handle a large amount of domestic wastewater and solid waste. Solid waste decomposes in the tank, while liquid waste seeps into the surrounding ground. As septic tanks do not require a large, expensive sewer system, they are often used when too few facilities are present to justify a sewer system, or when resources for such a system are not available. Septic tanks must be periodically pumped, at a frequency depending on the size of the tank and the level of use.

Biogas systems use effluent to generate methane gas, which can be used or sold by the owner of the system. Biogas systems can be built for single households or on a larger scale to service large cities. They have been used extensively in China and India, and are now growing in use in southern Africa. The city of Windhoek uses sewer effluent to generate over N$100,000 per year in energy. Biogas systems can also produce soil enrichment materials. Although they are less expensive to construct and maintain than conventional sewerage systems, biogas systems must be monitored to ensure that adequate effluent enters the system. Additionally, the knowledge needed to construct such systems is not widespread in Namibia at this time.

Decentralized wastewater treatment systems (DEWATS) are low-cost, scalable treatment systems that, like biogas systems, can be built on a household scale or sized to service municipalities (BORDA, no date). Unlike oxidation ponds used in many other water treatment systems, DEWATS systems are closed, non-evaporative treatment systems that produce water clean enough to satisfy environmental regulations and suitable for gardening or other uses of unpurified water. DEWATS systems can be used in conjunction with biogas reactors to produce methane and soil enrichment material. Although technical familiarity with DEWATS is not common in Namibia, the system offers an attractive resource recovery opportunity for an arid region.

Pit toilets consist of a hand-dug pit, over which some sort of toilet and shelter is usually built. Pits are used until they are full, at which point they may be emptied or covered over. The superstructure over the pit may be well or poorly constructed, depending on resources available.

Ventilation Improved Pit Toilets (VIPs) are pit toilets that have been designed to incorporate a ventilation pipe from within the pit to the outside of the shelter. This reduces odor within the toilet, and encourages drying of the waste. Additionally, if the structure can be kept dark, light entering through the ventilation pipe attracts insects that then become trapped at a screen over the outer end. This prevents insects from transmitting diseases that may exist within the pit.

Bucket and pail toilets represent a bare minimum in sanitation. Buckets are usually placed within a small structure and used to contain waste. They must be frequently emptied, although this is unlikely to be done safely unless the user or a local authority has planned a suitable manner and place to dispose of the waste.

The JoJo, Otji, Ecosan, and Enviroloo toilets are professionally designed dry sanitation systems that separate liquid and solid waste, allowing solid waste to dry until it can

be removed and thrown away or used as a fertilizer or energy source. The separation of solid and liquid waste may occur in a collection chamber, or through a urine diversion system in the toilet itself. These systems use no water and thus can be used where water is scarce or needed for other uses. A further advantage of these systems is that they can often be built entirely above-ground, making them ideal for flood-prone areas, places where the groundwater pollution is a concern, or where the ground is too rocky for excavation. Most of these systems must be imported, but the Otji Toilet is designed and produced in Otjiwarongo, Namibia. A diagram of the Otji toilet system is shown in Figure 7.

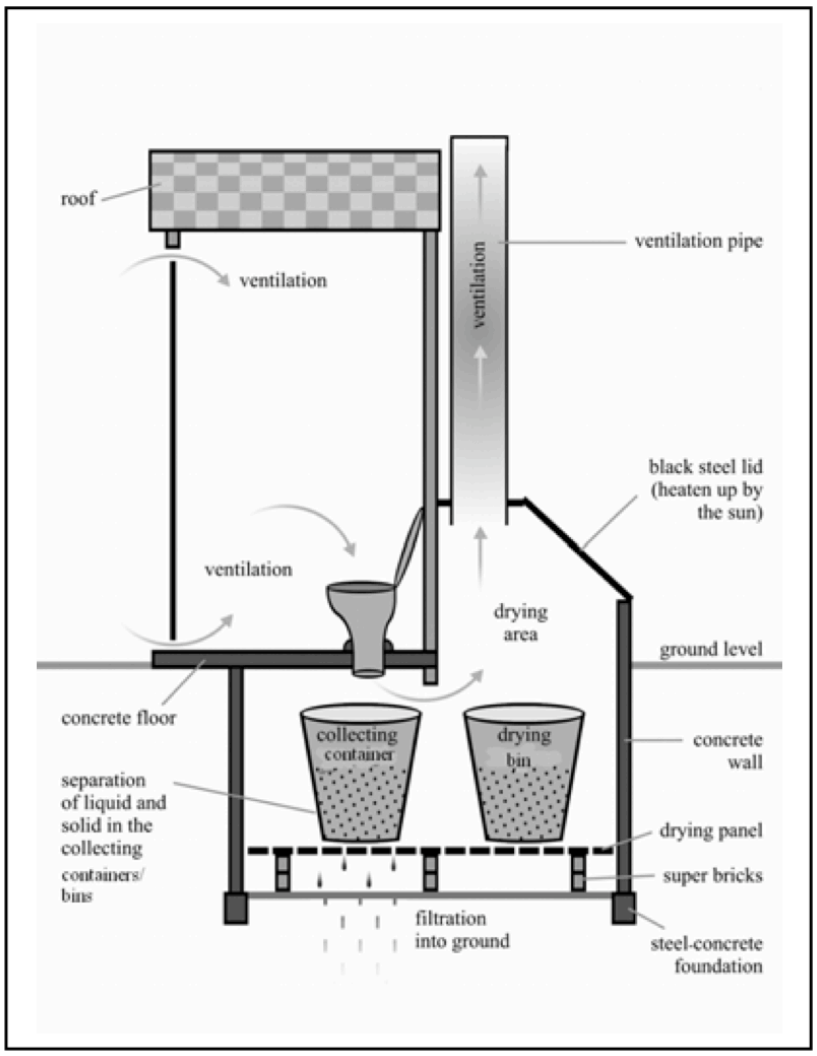

FIGURE 7: SCHEMATIC OF THE OTJI TOILET

(Clay house Project, no date)

Table 2 summarizes and compares the specific advantages and disadvantages of the sanitation methods discussed above.

TABLE 2: SANITATION METHODS, ADVANTAGES AND DISADVANTAGES

	Method	Advantages	Disadvantages
Wet Systems	Conventional Waterborne	Sewage treatment is highly effective.	Requires adequate, affordable water supply
		Technology and expertise are widely available.	Costly to build and maintain
			Requires education to ensure proper usage
	Vacuum System	Cheaper, faster construction and cheaper maintenance than conventional	Requires specialized expertise for operation and maintenance
		Lower water requirements (1L/flush)	Requires reliable electricity and backup generators
		Vacuum prevents pipe leakage and pollution	Some specialized equipment must be imported
	Decentralized Wastewater Treatment (DEWATS)	Low operation and maintenance costs	Lack of technicians and contractors in Namibia familiar with the system
		Highly scalable and tolerant of varying input amounts	
		Reusable wastewater and methane gas production possible	
	Biogas Digester	Renewable source of methane gas and fertilizer	Requires water
		Less expensive than conventional waterborne systems	Some skilled labor required for construction
			Monitoring required to ensure proper feed
Dry Systems	VIP / Pit Latrine	Inexpensive improvement over bucket and bush	Some risk of groundwater pollution
		Requires no maintenance aside from cleaning	VIP ventilation often does not perform as designed
	Dry System (e.g. Otji Toilet)	Requires no water	Many systems must be imported (except Otji Toilet)
		Low odor levels	Possible aversions to use of human waste
		Produces material for soil enrichment or energy production	

Sanitation methods can be organized around two major aspects: use of water and transportation of waste. Table 3 below displays this categorization for the sanitation methods we have discussed. Quadrant 1 of the table (Wet + Transport) contains the three widely used wet sanitation systems, while quadrant 2 (Wet + No Transport) contains the wet systems that offer resource recovery or production. Quadrant 3 (Dry + Transport) contains methods that are problematic and discouraged by planners, while quadrant 4 (Dry + No Transport)

contains the problematic bush system but also the highly attractive dry sanitation methods such as the Otji Toilet.

TABLE 3: SANITATION METHODS, WATER USE AND WASTE TRANSPORT

(Adapted from Wienecke, Mawisa, 2007)

	Transport	No Transport
Wet	Conventional sewerage Vacuum Sewerage Septic Tanks **1**	Biogas DEWATS **2**
Dry	**3** Buckets Pail Toilets	**4** VIP toilets Ecosan Pit Toilets Bush

Efforts to improve sanitation are necessary and perennially underway around the world. Many factors must be taken into consideration when selecting a sanitation system. The type of system used should be sustainable with respect to the environment, cost of operation, and effectiveness (Wienecke, 2007). Studies completed in Northern Africa and the Middle East emphasize the need to create a framework for sanitation that could identify the appropriate methods for use in impoverished areas, while at the same time helping to alleviate poverty (Saghir, Schiffler, & Woldu, 2000). These studies suggest that strong incentives for private operators would help to deal with sanitation issues. This research hypothesizes that in the future the cost of bulk water supply will be much less than the cost of sanitation services. While people see the obvious and direct correlation between life and clean water, they do not always see the need for proper sanitation. Improper sanitation can lead to disease and death. The following case study shows the steps taken in Tajikistan to improve sanitation and hygiene.

Case Study: Sanitation Education in Tajikistan

A cooperative effort between the United Nations Children's Fund (UNICEF) and the Government of Tajikistan began in 2000 and sought to invest in a sanitation and hygiene

program beginning with schoolchildren (UNICEF, 2004). Only fifty-one percent of the population was found to have adequate sanitation facilities in 2004. Many of these sanitation facilities are pit latrines, which emit foul smells and can spread disease. The program focuses on seven different aspects of sanitation and hygiene. These seven aspects are "Handling of drinking water, disposal of waste water, disposal of human excreta, disposal of garbage and animal excreta, home sanitation and food hygiene, personal hygiene, and community sanitation" (UNICEF, 2003,p.12). In order to provide education on these aspects the program engages the students in activities such as water testing, cultural shows, health monitoring and allows students to take responsibility at schools for monitoring areas around toilets and faucets (UNICEF, 2005b). Schools were chosen as the for a for the Sanitation through Schools program for many reasons. Schools are a central part of communities, and having them lead by example promotes sanitation throughout the entire community. Also, children are most likely to be receptive to new ideas and methods of hygiene, and people under the age of eighteen make up almost half of Tajikistan's population. Lastly, the school system in Tajikistan is well established with over 3,500 schools that provide education to over two million students. Implementation of this system has helped the risks of improper sanitation be addressed at a community level. Within the program each school day focuses on a different aspect of sanitation, and Sunday is designated a community demonstration day where students can participate in a neighborhood project. In some areas UNICEF has been able to provide slab latrines to schools and homes. Families are required to dig their own pit, and taught how to properly maintain it. New initiatives have included a National Children's Water Forum and other community based programs. Over 11,000 students and 250 schools are involved in the program and many more have been positively affected.

2.7.2 SANITATION IN NAMIBIA

Namibia has been making efforts to comply with the MDGs, but progress has been difficult in regards to sanitation. In 2005, Namibia's Minister of Regional and Local Government, Housing and Rural Development said in a statement to the UN that 41% of the country's population lacked "sanitary means of excreta disposal" (Pandeni, 2005, p.3). He also admitted that, of the 61% of Namibians that live in rural areas, 4 out of 5 are lacking proper means of sanitation. The great majority of households without safe water and sanitation are in the northern, rural areas of Namibia (el Obeid, Mendelsohn, Lejars, Forster & Brulé, 2001).

The following graphs show the results of the most recent (2001) census with respect to sanitation methods used in Namibia.

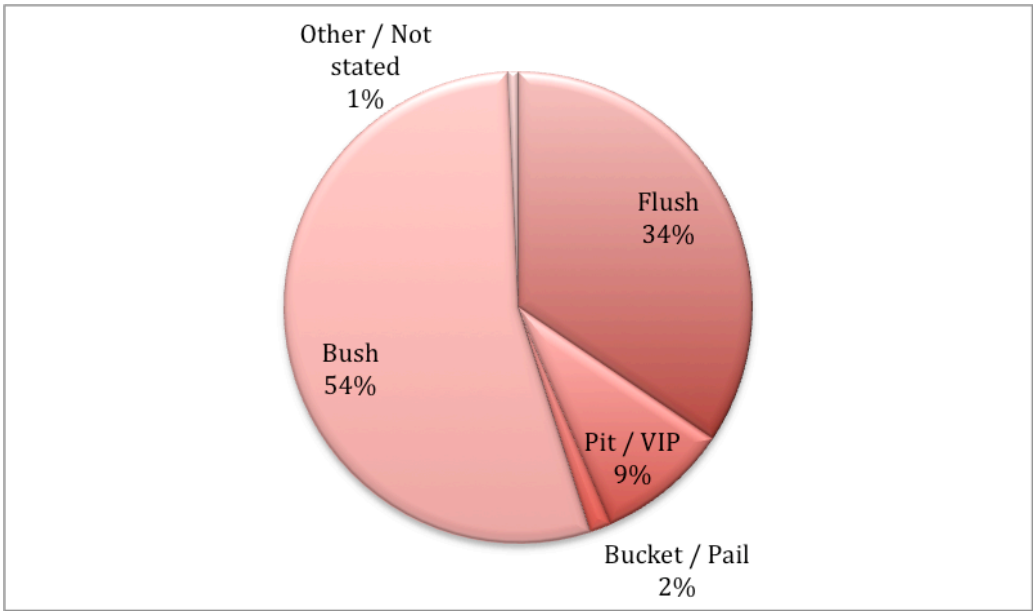

FIGURE 8: PERCENT USAGE OF SANITATON METHODS IN NAMIBIA

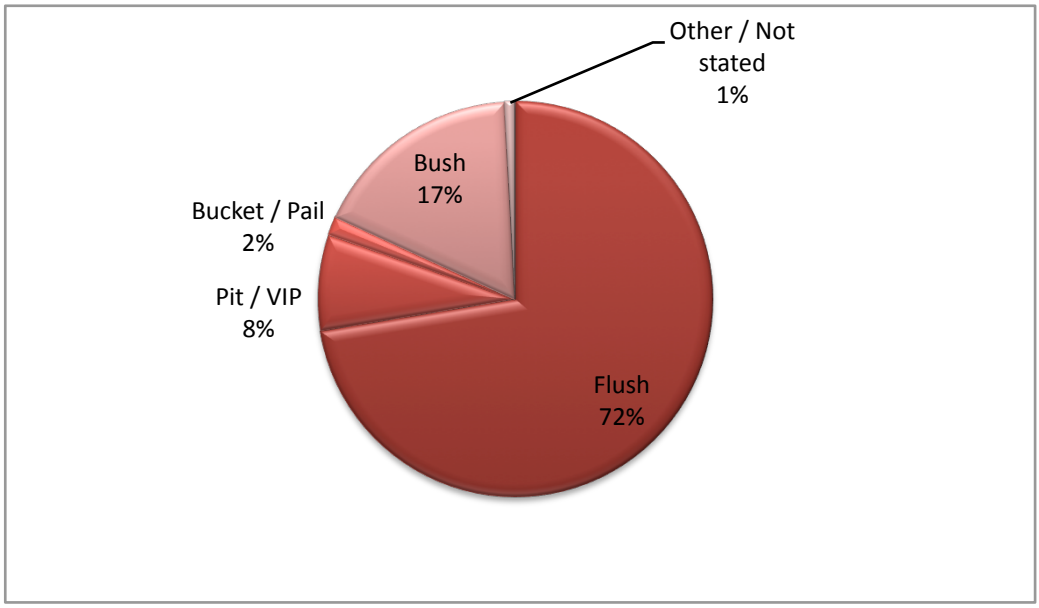

FIGURE 9: PERCENT USAGE OF SANITATION METHODS IN URBAN NAMIBIA

The proceeding table and charts make clear that flush toilets (sewerage and septic tanks) are much more common in Namibia's urban areas than in the nation as a whole. Whether this is true in the Fish River Basin will be a topic of our research. Additionally, the preceding data are seven years old at the time of this writing; new developments, population growth, and migration within the nation may also have had an effect on the state of sanitation in Namibia and in the Fish River Basin. Another factor complicating the interpretation of

census data is that many of the areas we will study in the FRB were considered rural at the time of the survey, and are thus not represented here.

2.8 BACKGROUND CONCLUSIONS

As we have seen, there are a wide variety of considerations to be made when assessing the potential for a Basin Management Approach in the FRB. These include general theories of basin management, the water and sanitation policies of Namibia, the physical environment of the FRB, and the social structures and dynamics of its residents. Implementation of basin management would require cooperation and understanding among all of these systems, both on the part of organizations like the DRFN as well as the individual stakeholders and community members who will benefit from the system they implement.

The information presented in this section is the foundation from which we have proceeded into our research. Our research methodology is presented in the following chapter.

3 METHODOLOGY

The goal of this project was to assess the potential for a Basin Management Committee to manage water and sanitation in the Fish River Basin (FRB). We determined the current state of water and sanitation infrastructure, cost recovery, water usage, and water management strategies in use in the basin. We also explored the local, regional and expert perceptions of the issues in the basin. The project was carried out in three stages. In the first stage we conducted expert interviews and prepared for fieldwork in the FRB. The second stage of the methodology took place during a two-week field expedition to the FRB, during which we visited local water authorities, regional council representatives, NamWater, and community representatives. In stage three, we identified patterns, strengths, and weaknesses with respect to water and sanitation management in the FRB, as well as the necessary prerequisites for a successful Basin Management Committee. We also arranged an interview with Water Masters, the main prepay water meter supplier in the FRB.

3.1 STAGE 1: INITIAL DATA COLLECTION

Stage one of our methodology included interviews with several key informants. These interviews took place in Windhoek, Namibia during the initial three weeks of the project. Informants supplied expert opinions and information on basin management, decentralization, water and sanitation infrastructure, water supply, cost recovery, and water usage in the FRB. These interviews helped provide initial perceptions about the basin and the plausibility of a Basin Management Committee. During this time, we also made preparations for our expedition to the FRB.

3.1.1 EXPERT INTERVIEWS

In stage one, we interviewed key informants who provided us with information about water supply and management, and sanitation, in general in Namibia, and the FRB, specifically. Interview questions were drafted and edited in consultation with the Water Desk at the DRFN (see Appendix B. Expert Interview Protocols).

Table 4 lists the key informants as well as their contributions to the project in terms of topics discussed. We initially had planned to interview only the first four informants listed in the table. A planned interview with the MRLGHRD could not be held. The last two

interviews took place to supplement the information that was acquired during those first interviews.

TABLE 4: EXPERT INTERVIEWEES

Name:	Organization:	Topics Discussed:
Martin Harris	Namibian Water Corporation	Water sources, supply and management in the FRB; cost recovery; role of NamWater as a bulk water supplier
Piet Heyns	Desert Research Foundation of Namibia Associate	Water infrastructure and maintenance; water supply to urban settlements; IWRM strategies
Dr. Andreas Wienecke	Habitat Research and Development Centre	Sanitation supply to urban settlements; sanitation infrastructure and maintenance
Ben van der Merwe	Environmental Engineering Services	Water tariff systems and cost recovery; water demand management; IWRM strategies
Erna Awaseb	Ministry of Health and Social Services	Sanitation with respect to health concerns
Hanjörg Drews	Namibian Water Corporation	Quantity of bulk water supplied to the basin

In addition to information gained through interviews, we acquired written material on the cost recovery system in Rehoboth, types of dry sanitation methods available in Namibia, and the volumes of water supplied by NamWater to each client in the FRB.

3.1.2 PREPARATION FOR FIELD EXPEDITION

The expert interviews and the preparation for the field expedition took place during the same time frame. Groundwork for the field expedition included making contact with local water authorities, regional authorities, the bulk water supplier, and community representatives in the FRB. During the initial contacts, their interest in participating in our project was assessed. It was found that all local officials contacted were enthusiastic about participating in our research. A second contact was then made with each local official to

request that they meet with us during our expedition and, in the case of local and regional authorities, that they gather the following quantitative information before our arrival:

- The volumes of unaccounted for and non-revenue water; i.e. the difference in the volume of water that NamWater supplies to the authority and the amount that is supplied to end-users.
- Tariffs that consumers pay for water and sewerage, including business consumers
- The difference between the accounts that the authority sends out per month and what consumers pay (what is collected at the end of the month, preferably over a period of one year).
- The total outstanding debt that consumers owe to the authority
- The total outstanding debt that the authority owes to NamWater
- Night water flow between 02h00 and 04h00 over a period of one year (which will give an indication of how well the water distribution system is working, because not many people will be using the water at this time and leakage will be easier to detect)
- The number of prepay and conventional water meters administered by each authority

Due to limited time and resources, we chose to visit a representative group of eleven urban areas in the FRB.

The selection of destinations to be included in our study involved consideration of several factors. In order to produce a representative list of urban areas, we evaluated each location according to the following criteria: an ability to supply data about water and sanitation, whether a Community Development Committee is in place, official classification as a settlement, village, or municipality, and location within the FRB. We then selected a sample of eleven destinations that spanned each of these criteria and were logistically reasonable for our two-week travel plan.

Table 5 summarizes the urban areas we considered and their specific characteristics. The urban areas we visited are bolded in the table.

TABLE 5: SETTLEMENTS CONSIDERED FOR THE FIELD EXPEDITION

Name	Region	Classification	Local Committee in Place?	Able to Provide the Data?
Ariamsvlei	Karas	Settlement	Yes	Yes
Grünau	Karas	Settlement	No	Yes
Klein Aub	Hardap	Settlement	Yes	Unknown
Noordoewer	Karas	Settlement	Yes	Yes
Schlip	Hardap	Settlement	Unknown	Unknown
Warmbad	Karas	Settlement	Unknown	Yes
Oranjemund	Hardap	Town	Unknown	Yes
Rosh Pinah	Karas	Town	Unknown	Unknown
Berseba	Karas	Settlement	Yes	Unknown
Bethanie	Karas	Village	Yes	Yes
Gibeon	Hardap	Village	Yes	Yes
Kalkrand	Hardap	Village	No	Yes
Malthöhe	Hardap	Village	No	Yes
Tses	Karas	Village	Yes	Yes
Mariental	Hardap	Municipality Part 2	No	Yes
Karasburg	Karas	Municipality Part 2	Yes	Yes
Keetmanshoop	Karas	Municipality Part 2	Unknown	Yes

Originally we requested an interview in Rosh Pinah, but due to road washouts and scheduling conflicts we opted to leave this mining town out of our trip. Instead we included another settlement, Grünau, to get a more accurate picture of the settlements in the FRB. In addition to requesting interviews and information from these places, we also requested quantitative data from other local authorities in the FRB as listed in Section 3.1.2. Finally, we attended a talk was given by Viviane Kinyaga and Dr. Mary Seely of the DRFN, in which they introduced the potential challenges that we may encounter in collecting data during our field expedition.

3.2 STAGE 2: FIELD EXPEDITION

Stage two consisted completely of the field expedition. Eleven urban areas were visited during the two-week period and thirty-one stakeholders were interviewed. Figure 10 shows the urban areas visited during our field expedition.

FIGURE 10: URBAN AREAS VISITED DURING THE FIELD EXPEDITION

In each urban area, interviews were conducted with the local water authority to inquire about the perceptions of water and sanitation issues and collect quantitative data. During the field expedition we were accompanied by Lucky !Ganeb and Clarence Mazambani from the DRFN. Each morning we held debriefing meetings to prepare for the daily interviews and at the end of the first week a presentation was given to Mr. !Ganeb and Ms. Mazambani summarizing the findings. Through the interviews we conducted with local authorities, we obtained knowledge about their water and sanitation infrastructure, tariff systems, and local perceptions of water and sanitation. The quantitative information requested during stage one was also to be collected during these interviews for review in stage three. We made an effort to meet with development committee members in each visited urban area, if such committees existed. Data collected during the interviews were entered into settlement profiles each evening.

3.3 STAGE 3: DATA COMPILATION AND ANALYSIS

Stage three of our methodology took place during the last three weeks of our project, after we returned from our data collection expedition in the Fish River Basin. During this time, we organized and analyzed the information we had collected in order to make recommendations for the steps that should be taken before a basin management committee could be implemented. We also arranged an interview with WaterMasters, the main prepay water meter supplier in Namibia, to follow up on some of the prepay water management concerns we discovered in the basin.

3.3.1 DATA PRESENTATION

During the course of our project, we collected a large amount of data of various types (numerical, factual, and subjective perceptions) from persons at various levels of the FRB water system (water and sanitation experts, regional officials and suppliers, local officials, and development committees). Simply gathering these data was an important step, but the manner in which they were presented determined the level of usefulness that the DRFN would find in our report.

Our findings are presented in four sections: Water, Sanitation, Tariffs and Cost Recovery Issues Record Keeping and Communication in the FRB. In each section we aimed to provide a complete picture of the current and proposed water and sanitation systems in the urban areas in the FRB. Important tables and graphs were added to supplement the findings provided.

We have organized much of our data into a series of standardized profiles of the urban areas in the FRB. Presenting our data in a standard way should allow the DRFN to more easily compare the areas that were profiled. This manner of presentation also should allow the DRFN to easily see where additional research will be necessary and to add new information or new profiles in the future. Each profile contains a set of basic information about the urban area (name, location, classification, population size, etc.) followed by a set of data fields corresponding to the objectives we have discussed above (sources of water, amount of water used, types of sanitation available, etc.). Some data proved unavailable or were available only as an approximation, but each profile represents the current state of knowledge about that settlement with respect to water management and sanitation. In Appendix D. Community Profiles, we include a one-page presentation of each urban area.

Complete profiles are not included in the body of our report. Although we have presented all data directly relevant to our conclusions and recommendations, the profiles have been included as appendices, so as not to include any extraneous information in the immediate discussion within the report.

4 RESULTS

The results of our research in the Fish River Basin are presented in this chapter. We also explore explanations and implications of our research, reserving conclusions and recommendations for the following chapter.

4.1 WATER

Although the topic of water has been thoroughly discussed in the background section of our report, the following information represents an overall picture of all aspects of water within the Fish River Basin: sources, infrastructure, uses, and quality.

4.1.1 SOURCES OF WATER

The common link between the different FRB settlements, villages, and municipalities visited during our field expedition is that they are all located in the same catchment area – the Fish River Basin. The actual source of the water supplied to each place varies, in that some use groundwater extracted through boreholes, while others receive their water from pipelines and canals coming from the Hardap, Naute, and Dreihuk Dams. Figure 11 below provides a pictorial representation of each source.

FIGURE 11: WATER SOURCES FROM LEFT TO RIGHT: BOREHOLE, NAUTE DAM, HARDAP DAM

Source: Wayat, F 2008, Namibia Water Corporation 2008

The only settlement visited during our field expedition that did not use the Fish River or boreholes as a source was Noordoewer, which receives its water from the Orange River. It should also be noted that in the Fish River Basin, Oranjemund and Rosh Pinah also use the Orange River as their main source of water. Urban areas using only boreholes for their potable water supply include Klein Aub, Kalkrand, Tses, Gibeon, Grünau, Bethanie, and Maltahöhe. This leaves Mariental, Noordoewer, Keetmanshoop, and Karasburg, as the only

urban areas we visited that use surface water as their main source of potable water. All of the municipalities in the Fish River Basin receive potable water from dams. Mariental's water is supplied from the Hardap Dam, Keetmanshoop from the Naute Dam, and Karasburg from the Dreihuk Dam (supplemented by boreholes; the dam supplies 70% of the Karasburg's water). Some of the settlements we visited are also using other unpurified or less expensive sources of water to supplement their bulk water supply bought from NamWater. These sources are either fountains (natural springs) or boreholes owned and operated by the local authority. The one exception to this is Mariental, which uses unpurified water supplied directly to the municipality from the Hardap Dam.

The quantities of water used by each urban area per month vary seasonally. Figure 12 depicts the amount of water each urban area received monthly from NamWater from July 2005 to January 2008.

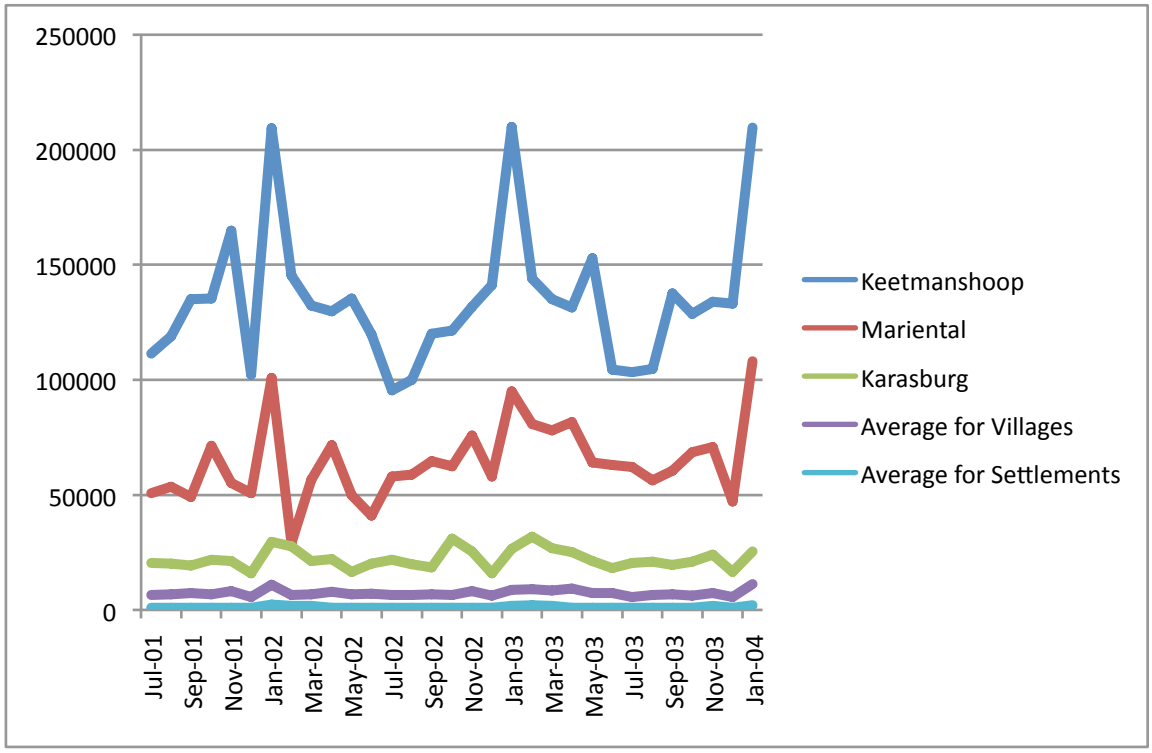

FIGURE 12: MONTHLY VOLUMES OF WATER SUPPLIED BY NAMWATER TO LOCAL AUTHORITIES (JULY 2005 - JAN 2008)

As shown in Figure 12, the amount of water supplied by NamWater to local authorities is directly related to the size of the location the water is being supplied to, as would be expected. For comparison purposes, since both villages and settlements have little variance in the amounts of water received, values for these urban areas have been averaged to display the relationship between municipalities, villages and settlements. For specific values of the volumes of water supplied to each urban area visited during our field expedition, refer

to Appendix E: Quantitative Data. Keetmanshoop and Mariental have water supply rates that are much higher than the other smaller communities in the FRB. This is most likely a result of them being the largest urban areas in the FRB. An interesting relationship in Figure 12 is the seasonal changes in water use throughout the past two and a half years. As shown on the graph, most noticeable in Keetmanshoop and Mariental, there is a large peak in the volume of water supplied every year in January. This peak in water use can be explained because in Namibia, this time is often before the rainy season has started in the FRB, and consumers must rely more heavily on water supplied to them by the Local Authorities. This is also the holiday season, which may intensify this peak. During the winter months, particularly around July, the water the water supplied is significantly less.

As a result of the ever-rising cost of water supply, some urban areas have been looking into other sources of water. For example, the local authority in Gibeon expressed an interest in utilizing a natural spring located near the town as an alternate source of water. This water could be used as an unpurified source for activities such as gardening, washing and other household use but concerns about the water supply for local vegetation have been raised. Therefore, potential environmental impacts should be assessed before these sources are utilized.

NamWater has declared the water from one such natural spring unfit for human consumption by World Health Organization (WHO) standards. During our interview, we were informed that plans for a water bottling plant from this spring are being investigated. The local authority in Gibeon, as well as in others in the basin, raised questions as to why the village is not able to tap into such a source. The Bethanie Village Council owns two boreholes and hopes to use them as additional sources of water to reduce the costs of using purified water. The boreholes have yet to be approved by the Ministry of Agriculture, Water, and Forestry for use. In Kalkrand, members of the Community Development Committee are interested in exploring alternative water sources, such as natural springs. In Noordoewer, there is no formal alternate water source supported by the local authority, but community members sometimes use the canal for domestic uses. Problems associated with unintended consumption of unpurified water sources will be discussed in Section 4.1.3, on water usage.

4.1.2 WATER INFRASTRUCTURE

NamWater supplies the urban areas in the FRB with bulk water from dams and boreholes. First water is extracted from the boreholes and the dams. From there the water is

purified and tested at NamWater treatment plants. After being deemed safe for consumption, it is delivered to the local authorities. From this point onward, the local authorities are responsible for distributing water and maintaining the local water infrastructure. Here, consumers access water through standpipes or household taps. Both standpipes and taps can use either a conventional meter or prepay meter to record the amount of water that is accessed through the tap.

Water Distribution

The major difference between standpipes and household taps is that standpipes are generally communal taps, used by multiple households, whereas household taps are individually owned. In the informal areas, standpipes are more common because multiple households can share them. Typically 5 or 6 households share a tap located centrally, not more than 300 meters from the house. To ensure each community member is only paying for the water they are using, prepay meters are always used on standpipes that are metered.

Table 6 shows the number of communal taps (standpipes) and household taps in each of the urban areas we visited. Household taps are far more common than communal taps, which tend to be avoided but are still used in the informal settlements. Household taps are both more convenient for the users, and have less risk of vandalism, which may account for the overwhelming majority of individual taps as opposed to standpipes in every urban area in the table. Out of the total number of water taps in the entire Fish River Basin, a dominating 99% of them are household taps, as opposed to communal standpipes.

TABLE 6: WATER DELIVERY SYSTEMS IN EACH URBAN AREA

Location:	Classification:	Household Taps:	Communal Standpipes:
Grünau	Settlement	44	4
Noordoewer		215	5
Bethanie	Village	569	10
Kalkrand		23	14
Tses		176	13
Maltahöhe		146	2
Mariental	Municipality	2360	30
Keetmanshoop		3617	0

Note: We were not able to acquire data from Klein Aub, Gibeon, or Karasburg on the number of household and communal taps in each urban area.

One common trend was that individual taps with conventional meters are used more often than prepay meters in the formal areas. The difference between prepay and conventional meters is that conventional meters simply record the amount of water accessed through the tap, while prepay meters only allow the consumer to access the amount of water that was paid for prior to use. Most local authorities mentioned that they would like to install prepay meters to aid in cost recovery programs but the current situation does not reflect this. Currently, the amount of conventional meters in each urban area exceeds the number of prepay meters, with the exceptions of Grünau and Bethanie. The data we gathered on the number of each type of meter in each urban area are shown in Table 7.

TABLE 7: PREPAY ANDCONVENTIONALMETERS IN THEFRB

Location:	Classification:	Prepay Meters:	Conventional Meters:
Grünau	Settlement	24	24
Noordoewer		90	130
Bethanie	Village	384	195
Kalkrand		14	23
Tses		12	176
Maltahöhe		148	ND
Mariental	Municipality	120	2300
Keetmanshoop		0	3617

Note: Only 8 of the 11 urban areas are included in this comparison. In Karasburg, prepay meters are not used and the number of conventional meters was unavailable. We have no data for Klein Aub or Gibeon. ND = no data.

Conventional meters represent 91% of the total meters in the 6 urban areas shown in Table 7. Although this percentage is only representative of the urban areas where we acquired data and not the entire FRB, it still provides a good perspective on the overall trends within the Basin.

Vandalism of water meters and taps is a problem in many urban areas. People use spoons or other objects to pry the tap open to get water out of it. An example of how this can be an effective method of "stealing" water was given to us during our interview. Although not in the FRB, it still shows why someone may vandalize a tap. We were told a story of a community member who was able to open the tap just enough to get water to drip out without the meter recording the amount of water used. A good deal of water can be drawn from a dripping tap without ever being recorded by the meter if this tap is left in this condition for an extended period of time.

While prepay meters may alleviate some issues with cost recovery, there are a few problems that should be addressed. One common complaint about prepay meters was that when the meters break, replacement parts take a significant amount of time to arrive because they are only available in South Africa. There were also problems noted with the computer system for the meters. When prepaid tokens or cards are used in non-communal prepay meters, the tokens become "married" to the tap and are unable to be used elsewhere. If tokens are inappropriately used on another system, they no longer function with the original meters.

When this happens the local authority must reprogram the token. When tokens are used with non-communal prepay meters, the balance on the token is transferred to the meter itself. When this balance runs to zero, the local authority has two options. The first is to stop water from flowing to these users until they add credit to their token. The second is to allow water to continue to be accessed from the tap, bringing a negative balance to the token account. This negative amount would be deducted when additional funds are added to the token.

FIGURE 13: DELIVERY METHODS TO USERS
(FROM LEFT TO RIGHT) CONVENTIONAL METER, YARD TAP, STANDPIPE

In the majority of the urban areas we visited, the prepay meters are preferred and desired by both community members and local authorities, even though these problems are common. Many of these meters are supplied from a company called Water Master. In order to get both perspectives on the situation, we interviewed two representatives from the company when we returned from our field expedition. The following information was gathered during our interview with the company:

Supplementary Information on Water Master, a Prepay Water Meter Supplier

Water Master, whose main office is located in Windhoek, was founded in 1998. The company is the primary provider of prepay water meters throughout Namibia and has an agreement with a prepay meter manufacturing company in South Africa to be the only company to which the meters are supplied in Namibia. The company has considerable experience in this area, and as far as we know, company has the most experience with prepay meters in Namibia. Although they do not manufacture the prepay meters themselves, they provide installation services and necessary software. Currently, Water Master provides its

services to 48 customers, mostly local authorities, in Namibia, and is still expanding their customer base.

Water Master currently sells two types of meters, one for communal standpipes, and the other for private taps. The prepay meters for taps cost N$1,875 each, and meters accompanying standpipes cost N$4,000. Both metering systems work with prepay tokens that are programmed with software provided to the customer. Although there have been some problems with the meters in the past, the company has improved with more experience.

Water Master currently employs four personnel responsible for dealing with maintenance issues reported by their customers. The owners stressed that regular maintenance must be performed, even though many areas are not taking preventative measures. As evidence to support this claim, they cite an example of a project in Northern Namibia where 150 meters were installed, and problems have only been reported with 3 of these meters. As the users themselves maintain the meters, this example shows that if proper care and maintenance of the meters is performed, no significant problems occur. Although the company provides its own training about the meters and software, it has often been ineffective. To solve issues with maintenance, Water Master is hoping to provide their own maintenance program of the meters once they are installed.

During our field expedition numerous interviewees said that when meters broke, it took five to six weeks to receive the parts necessary to fix the meter. Water Master has attempted to address this problem, and now submits monthly forms to the distributor on which they give a monthly estimate of replacement parts they will need. Originally Water Master was working with a company that would not keep the parts in stock, but after switching companies the inventory has been expanded and the problem has been resolved. Now it only takes 4 business days to receive parts at the main office in Windhoek from which they are then distributed.

Water Master has had trouble receiving payments in the past. Three years ago the company began offering a package to their customers, which included installation of meters, revenue collection for the local authority of water bills, and maintenance of meters. This strategy helped to recover costs for capital projects for which they put up the money for to start, and then attempt to recover them later. This method has been effective; although it often takes more time to recover costs, they are assured that they will be paid. Water Master is currently working on creating a payment program for any new projects they begin to alleviate problems in this area. Because we received many complaints about Water Master

and their services from local authorities in the FRB, and we shared that the information during our interview, the company admits it has problems, and is working towards improving themselves and providing better customer service.

Water Infrastructure Maintenance

The level of maintenance of the water infrastructure in each settlement varied greatly from place to place, although all locations visited had some sort of maintenance problem. In a majority of the urban areas the water infrastructure was old, and the pipes were made of asbestos. When asbestos pipe systems age twenty or more years, corrosion becomes a significant problem and pipes begin to burst. In Keetmanshoop, the Regional Council members showed us an example of such a pipe that had been used for more than twenty years in one of the settlements the Regional Council manages. It is shown below in Figure 14.

FIGURE 14: CORRODED ASBESTOS PIPE

With regards to the number of maintenance personnel per capita in each urban area, there are variations that depend on the population of the urban area (which is expected when comparing large and small areas). Data representing the maintenance personnel permanently employed by the local authority in each urban area per 100 people are shown in Figure 15. A larger infrastructure requires a larger maintenance team to operate it efficiently. Typically, settlements and villages have one or two maintenance workers, while the larger municipalities, such as Keetmanshoop, have upwards of 10 personnel to deal with maintenance issues. The graph shows an inverse ratio between the population size of an urban area, and the number of maintenance workers employed there.

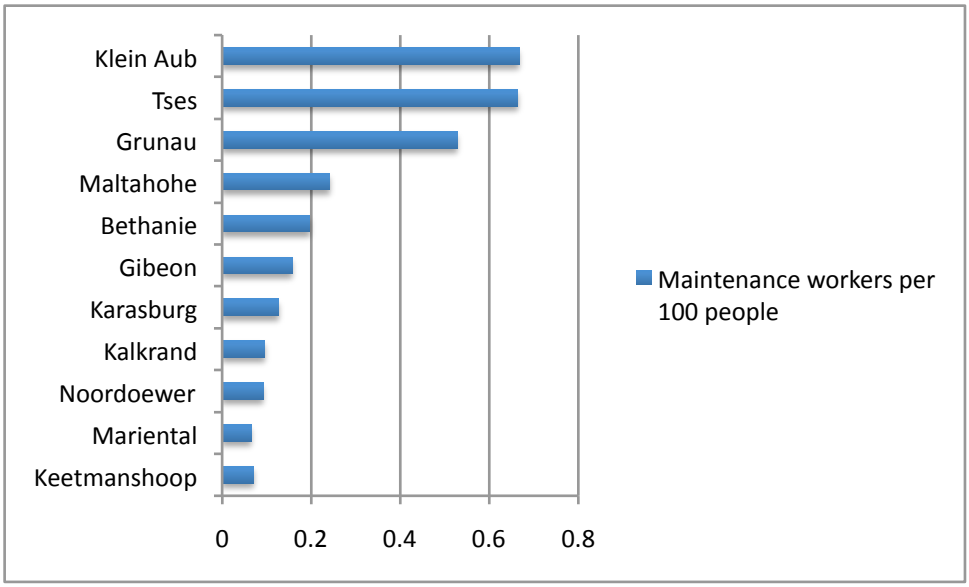

FIGURE 15: PERMANENTLY EMPLOYED MAINTENANCE PERSONNEL PER 100 PEOPLE

Figure 15 depicts the number of hired maintenance personnel in each local authority office, not how many community members deal with maintenance issues independently. As a result of a project conducted in the informal settlement of Illeni in Keetmanshoop that involved community members who received on-the-job training, the municipality has a larger base of skilled community members who can provide assistance. This is not the case, however, in many of the other locations we visited. Settlements are not typically able to deal with large maintenance issues on their own, and have a limited number of maintenance personnel. When there is a significant issue with the infrastructure in these settlements, the Regional Council is called upon to provide assistance with repairs.

Figure 16 depicts the number of maintenance personnel per hundred water meters in each urban area of the FRB. The highest ratio is 3.85, which is hardly sufficient unless problems do not exist, which was not the case explained during our interviews. By far the worst off in this regard is Mariental, whose ratio is less than .25. The number of maintenance personnel is insufficient in nearly every urban area of the FRB, and something must be done to resolve this issue.

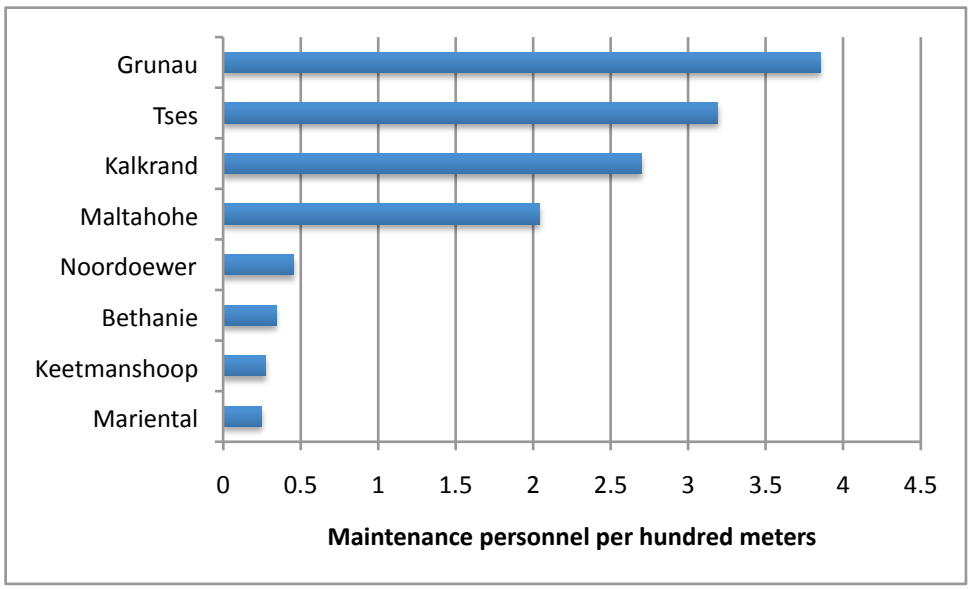

FIGURE 16: MAINTENANCE PERSONNEL PER HUNDRED METERS

As a result of the old water infrastructure and insufficient amount of maintenance workers in each urban location water loss from pipe bursts is common occurrence. Depending on the urban area, the percentage of water lost varies greatly. During our field expedition, we obtained quantitative data that allowed us to calculate the percentage of water loss in three urban areas shown in Table 8.

TABLE 8: WATER LOSS CALCULATIONS

Location:	Water Sold by Local Authority to Consumers:	Water Purchased from NamWater:	Percentage of Water Loss:
Keetmanshoop	831796	1208268	31%
Karasburg	163173	187283	13%
Bethanie	43953	72895	41%

Based on these three locations, it is apparent water loss is a considerable issue. Even in Karasburg, where the percentage of water loss is the least, representatives we spoke to mentioned that this is still too much, and a water loss of 9% would be normal. A water loss of 41% reflects the inability of the two maintenance workers in Bethanie to find and repair the entirety pipe bursts in the village. Such a major loss was also reported by the Village Council in Gibeon, who said they had a 49% loss before replacing the old infrastructure. Now that the infrastructure has been replaced, water losses have been reduced to approximately 20%. Such a significant water loss also hinders the ability of the local

authority to recover costs. Some local authorities would have to charge residents twice as much as they pay per unit of water, in order to fully recover costs. Although many urban areas are beginning to replace the old asbestos pipes with Polyvinyl Chloride (PVC), replacing pipes is often time consuming and is very expensive. Nonetheless, this issue must be addressed.

Training

The training that maintenance personnel receive varies a great deal depending on the urban area. The majority receives in-house training and gains experience by working for a long period of time under the supervision of someone with more experience or training. In order to improve the current situation regarding the lack of technically trained people, we discovered one promising solution to this problem. This solution was discovered during our interview with Patrick Hamann, the town engineer and acting CEO of Keetmanshoop. The municipality's project in the informal settlement of Illeni provides a noteworthy example of how the issue of shortage of trained personnel can be addressed.

The project to develop the informal settlement of Illeni, in Keetmanshoop, began in 2002 and took approximately 9 months to be completed. This project is considered to be a great success because Hamann was able to involve community members in a people-centered approach, where the locals were involved in every step of the project: planning, construction, and maintenance. When the project in Illeni was finished, the entire informal settlement, consisting of 300 plots of land, was serviced with individual water taps, sewer reticulation, and electricity (Hamann, 2007). Gravel roads were also placed throughout the settlement, to reduce dust. No informal settlement in any other location in the FRB can boast of such success, and Hamann is clearly proud of Keetmanshoop's accomplishments in this area.

Case study: Development of Informal Settlement in Keetmanshoop

Patrick Hamann's vision was that the informal settlement, located on the outskirts of Keetmanshoop, is provided with the same services as all other residents in the municipality to reduce the negative stigma associated with the informal settlement. The Illeni settlement project was developed as a community project, whereby the locals constructed most of the work under the supervision of the project planners. The basic goal was to "integrate others' experience about upgrading infrastructure into a methodology suitable to be used by other local authorities. Most people living in informal settlement areas suffer severe economic

stress and poverty caused by low levels of education, lack of skill, lack of job opportunities and lack of access to basic water services" (Hamann, 2007, p.4). Thus, by involving members of the informal settlement in a project, sustainable economic opportunities were created, and problems were alleviated. Furthermore, involving community members in this work created a base of skilled workers who could be drawn from in the future.

In addition to creating a larger group of skilled laborers, there are other benefits to involving community members in such a project. The first and most obvious benefit is that those living in the informal settlements know "the local conditions and limitations and may have a better understanding for broad based needs and aspirations" (Hamann, 2007). A good deal of planning is involved in order for the project to be successful. Community members must actively participate and take a leading role to ensure that their needs and concerns are being addressed, and that they will be satisfied once the project reaches its conclusion. They must work hand-in-hand with project planners and must be carefully chosen. Qualified persons must possess the following attributes in order to be most effective: expertise, trustworthiness, reliability, friendliness, professionalism, and be personable (Hamann, 2007). It is very important that both community members and project supervisors are carefully chosen.

Another significant benefit to involving community members in such a project is that they will develop a sense of ownership. In this case, the locals became custodians during the project and continued once the project is completed. Involved community members were observed "safeguarding the project against possible theft and threats" (Hamann, 2007, p.44).

Finally, involving the community members in such a project drastically reduces the costs associated with such an endeavor. Involving the residents of Illeni in all of the civil construction work, and presenting it to them as part of their contribution to the project, the services can be accessed at a rebated labor fee. This step ensured that all work was of outstanding quality (Hamann, 2007). In addition, if the local authority utilizes a qualified person "to lead the process from within the authority, all associated fees of supervision and design can be minimized" (Hamann, 2007, p.47).

As the project has reached its conclusion, there were very apparent outcomes that had been achieved. These benefits, explained in more detail above, include the creation of a group of skilled workers, reduced costs, and a sense of ownership. These three attributes result in quality work done on the project during the construction phase, as well as proper maintenance of the infrastructure after completion. Also, at the conclusion of the project residents learned and appreciated the fact that "the municipality has their problems at heart"

(Hamann, 2007, p.61). As a result of the success of this project, it will be expanded upon, and an additional three hundred plots will be serviced; effectively doubling the size of Illeni.

Through using this project as a guide, it is believed that other urban areas in the Fish River Basin could benefit substantially if efforts to upgrade their informal settlements were made. Not only does the Illeni project address the improvement of informal settlements, but also it provides an excellent solution to the problem communities are facing with a lack of a skilled labor force to deal with maintenance issues. The Illeni project should be looked to as an example in this respect.

4.1.3 WATER USAGE

Although the consumption of water is a necessity for life itself, other types of water usage include bathing, washing clothes and dishes, and watering plants and lawns, as well as irrigation on farms. With the exception of small individual gardens in some of the urban areas, irrigation was not used within the urban areas. As stated above, due to issues with cost recovery (discussed in Section 4.3), many areas are looking into new, alternative water sources. Many local authorities have tried to tap into unpurified water sources like boreholes, or natural springs, whose water is intended for non-consumptive purposes. The general consensus about the use of this water is that it will reduce the amount of potable water necessary, because it will not be used for consumptive purposes. In turn, since unpurified sources are cheaper, water related costs would be reduced.

During our field expedition, we encountered multiple examples where these unpurified sources were either in use, or being researched. In Keetmanshoop, a pump just outside of the informal settlement provides unpurified water free of charge. The municipality is also using two municipal boreholes to provide water for lawn care and to fill the public swimming pool. In Mariental, the municipality sells unpurified water, supplied directly from the Hardap Dam, for a unit price of N$1.00 (per cubic meter) to the users. None of this water is supposed to be consumed and these systems seem to be working well, but other areas are having more difficulty controlling the consumption of unpurified water.

The main issue with unpurified water sources is that community members simply see it as a cheaper source of water. The risks associated with drinking such water are either not understood or cared about enough to prevent consumption. If consumers are not paying their bills, some local authorities shut off water to residents completely until their bill is paid. When the water connection is shut off due to unpaid bills, or when community members

cannot afford to pay for potable water, they often resort to using other available sources such as the inexpensive or free unpurified water as a viable option. Others simply may not realize the health risks associated with consumption of non-purified water or are negligent when the health impact is not immediate. It is uncertain how this issue should be addressed. In Noordoewer, the untreated canal is often used for bathing and washing clothes. Pollution from those who use the water in this manner creates a potential health risk for anyone who consumes water from this source.

To combat this problem, authorities in Noordoewer are using multiple strategies to stop people for using this water. First, through community meetings, the settlement officer explains to community members that the water is unfit for human. Sometimes letters are sent out to the community to convey the message as well. In addition, the local authority is also trying to involve police in monitoring canal use and instituting a fine for those caught using the water for any purpose. Water source contamination and reported cases of sick community members are common in areas where community members use unpurified water sources, and efforts to prevent such problems must be formidable if these sources are to be used without these problems.

In addition to the aforementioned domestic uses, water is also necessary in order to successfully undertake development efforts, especially those involving agriculture. This was a concern raised by some local authorities, who explained that a lack of water is preventing them from undertaking development efforts that could improve the lives of residents. In Noordoewer, the school principal struggles to keep children cool during the day. There is no water available for watering trees that could provide shade, nor for agricultural projects that he would like to pursue. The troubling and confusing aspect of this situation is that Noordoewer and the school have enough money to purchase the water necessary for such projects, but NamWater refuses to supply them with it. It is possible the reason for this is that NamWater is concerned about the sustainability of water in the region. In Karasburg, like many of the urban areas we visited, the municipality is confronting serious unemployment problems that could be alleviated by manufacturing or agricultural projects, but there is simply not enough affordable water for such projects to move forward.

4.1.4 WATER QUALITY

During our interviews most local authorities did not consider poor water quality a significant issue. Some mentioned that water in the area is highly saline, or “brackish”.

Others mentioned that the amount of fluoride in the water was a slightly more significant issue because children had problems drinking it, and it caused the color of residents' teeth to change.

However, in some urban areas authorities mentioned significant water quality issues. Bethanie is supplied with Class C water from NamWater, which, by World Health Organization standards is not fit for human consumption. Concerns were also raised in Tses where diarrhea and high salinity are an issue. The only other location to cite concerns with water quality was Grünau, where the water is brackish and leaves calcium deposits on dishes. No health problems were cited in relation to these calcium deposits, however.

Based on a NamWater assessment of water quality, Martin Harris, a NamWater official, suggested that the four most abundant and significant issues in the Fish River Basin are fluorides, nitrates, sulfates, and salinity. High fluoride content in water results from the source itself, as the fluoride content in water from fractured aquifers used in the FRB is high. The locations we visited that were cited with high fluoride content in the NamWater report, were Bethanie and Grünau. The main issue with high fluoride content in the water is in children, since their bodies are unable to process it as well. High fluoride content also causes consumer's teeth to change color. Problems with high nitrate content in the water typically are a result of contamination from sanitation systems, or from people using such places as the riverbed to relieve themselves. As a result, health risks can be serious in such cases. Maltahöhe has the highest rate of nitrates in its water supply (as cited in the NamWater information), but the CEO in Maltahöhe had not heard of anyone complaining of health issues due to water quality. The final contaminant mentioned by Martin Harris, and that which holds the biggest health risk, is sulfates. Although Harris did not mention which locations had issues with sulfates, such pollutants can cause major health issues, specifically stomach problems and diarrhea. Informants interviewed in Tses and Bethanie raised such complaints of health issues. One cause of this could be that there is a high sulfur content in the water supply.

NamWater performs its own testing of the water it supplies to each local authority. For the most part, consumers trust that the water is of good quality, unless they are otherwise notified. None of the local authorities we visited test the water they supply to their community members, unless concerns are raised.

During our interview with Andreas Kok, NamWater's regional manager responsible for the Fish River Basin south of Mariental, we learned that NamWater conducts quarterly tests (every 3 months), to determine the bacterial, chemical, and mineral composition of their

water. NamWater uses chlorine to purify the water, and tests are run every two hours to ensure that the amount of chlorine is sufficient to purify the water, but also not so high that it will cause health risks. At its boreholes, NamWater runs a chemical analysis twice a year.

NamWater standards during these tests are based on the World Health Organization (WHO) standards. These standards state the appropriate levels of chemical, mineral, and bacterial content in order to be safe for human consumption and are broken up into four classifications: A, B, C, and D. Class A is deemed excellent. Class B is suitable for consumption. Class C is termed "water with a low health risk". Class D is unsuitable for human consumption. In the majority of the FRB locations, Class B water is supplied to the urban areas, with exceptions in a few places that receive Class C water. Under regulations, NamWater is allowed to supply Class C water to its consumers, as long as the company informs the consumers why the water is under that classification. During the interviews with both Andreas Kok and with Martin Harris, we were told that NamWater might soon have to comply with stricter standards for water quality, as WHO is changing its current water quality standards. To meet this stricter standard, NamWater may have to change its purification process from chlorination to reverse osmosis, which will cost the company a large sum of money.

4.2 SANITATION IN THE FISH RIVER BASIN

Water and sanitation are inextricably related, especially in an arid country (Andreas Wienecke, personal communication, March 20, 2008). In this section of the report, we will discuss the use of various sanitation methods in the basin, and describe the major problems, successes, and development trends that we have observed.

4.2.1 SANITATION METHODS

Methods of sanitation vary greatly in and among the urban areas that we visited. Of these eleven locations, seven make some use of bush or bucket toilets, while seven are at least partly served by modern sewerage systems (In three cases, sewerage and bush are being used in the same area).

Table 9 shows the occurrence of each sanitation method used in the visited urban areas.

TABLE 9: SANITATION METHODS USED IN VISITED URBAN AREAS.

	Conventional sewerage	Vacuum	Septic	Pit	Bucket	Bush
Bethanie	1		1		300	
Gibeon	ND	ND			ND	
Grünau			10	20		
Kalkrand			78		79	
Karasburg	591		420			
Keetmanshoop	3617					
Klein Aub	ND		ND			3
Maltahöhe	ND		ND			273
Mariental	ND					ND
Noordoewer			10	ND		
Tses	79			ND	42	

Shaded box indicates reported use. The number of users/facilities is given where known. ND = no data.

Taken together, the three wet systems – conventional sewerage, vacuum, and septic – are present in every visited area. Septic tanks and conventional sewerage are equally common, although septic tanks are usually used on a smaller scale. In some cases this may be because the large capital required to build a sewer system was not available or justified by the small number of facilities needed. In other cases, the existing septic tanks are facilities that remain to be upgraded to sewerage along with other facilities in town. The vacuum system, although it can offer significant cost and water savings over conventional sewerage, is the least common system we observed, occurring in only one of the visited locations. This is due to the fact that the system has only recently been introduced to Namibia.

Dry sanitation methods are in use in all but two of the visited locations, the bucket system being the most common. Use of bush was reported in three places, although Mary Seely, a DRFN associate, informs us that the bush is used to some degree virtually everywhere in Namibia (personal communication, April 26, 2008). Pit toilets were reported in three places. While the pit toilet can offer the most hygienic dry sanitation method of those we observed in the field, it has the greatest requirements in terms of infrastructure (i.e. a pit must be dug, and a covering structure must be built and maintained). The pit toilets we observed in Tses had been built with assistance the Ministry of Health and Social Services, which has a program to provide VIP toilets (described in Section 2.7.1) to people lacking

proper sanitation facilities. Although, the local authority reported that these toilets are generally well maintained, this program is unavailable in municipalities like Mariental and has provided only 112 VIP toilets throughout the Hardap and Karas regions since its inception in 2001 (Awaseb, personal communication, 2008).

4.2.2 CURRENT PROBLEMS IN SANITATION

The clearest sanitation problem in the Fish River Basin is the use of the bush and bucket systems, primarily in informal settlements. As may be expected, the bush system is completely unregulated in the places we visited. In fact, little seems to be known by local authorities besides the fact that it is used. The degree to which bush use may be contributing to human health issues in these locations is therefore unknown. Finding this information would require on-the-ground investigation into the bush areas that are used, including the frequency and manner of their use, and their proximity to ground or surface water and population centers. Even without such information, however, the general unhygienic nature of bush use is well established.

Use of the bush also presents significant public safety issues. Bush areas are naturally some distance from homes and businesses, making venturing out at night to use the bush a dangerous proposition, especially for women. Mariental has experienced problems with assault, mugging, and rape in bush areas. Local authorities are hesitant to regulate - and thus partly legitimize - the use of the bush, so efforts to address this issue are usually along the lines of providing alternative sanitation facilities. While this strategy makes long-term sense, construction and successful implementation of such facilities requires financial and labor resources that are not always available. Public safety issues will continue to exist until better sanitation facilities are available and attractive to users.

By contrast with bush, the bucket system is relatively well regulated. Many local authorities offer some sort of bucket-emptying program, so the numbers of buckets being used in the visited locations were often available (as shown in Table 10). As a result, at least the scope of the potential bucket-related problems is known by local authorities. The most significant problem we observed with the bucket system is the task of emptying buckets. Although emptying buckets is imperative to prevent health issues, we observed that many local authorities are unable to do so regularly and safely. In Kalkrand, for instance, the tractor used by the village to empty buckets had been in disrepair for over two weeks upon our arrival, leaving the 79 buckets there to be emptied by users. In Bethanie, a lack of

personnel makes emptying buckets difficult, especially on long holiday weekends when people are forced to empty buckets themselves. When users are forced to empty buckets themselves, waste is often dumped in neighboring yards, streets, or other places in the immediate vicinity of homes. Under such conditions, the bucket system may be an even greater public health hazard than bush use would be.

Pit toilets are being used in three of the urban areas that we visited. Although pit toilets can be somewhat effective when well built and maintained, such was the case in only one of the three locations where we observed them. In Tses, the pit latrines used in the informal settlement are VIPs provided by the Ministry of Health and Social Services. Their relatively good state of repair may be explained by the fact that VIPs are of a better design than most self-built pit latrines, and by the fact that they have been provided to individual households who have a stake in maintaining them.

By contrast, the pit latrines in Grünau and Noordoewer are self-dug and sometimes communal. When one of these pits is filled, another one is simply dug nearby. They are entirely built and maintained by the users and therefore may present health hazards that are unknown to the local authority, especially in Noordoewer where groundwater is relatively shallow. Grünau has reported problems with infection due to poor maintenance of pit toilets, but the settlement office lacks personnel and resources to address this problem.

Problems with wet sanitation in the FRB are fewer, mainly because such systems require a more elaborate infrastructure that is planned and monitored by local authorities. Septic systems are one of the most common sanitation methods we observed. Because they are flush systems, many of the health issues that arise during the use of bush, bucket, or pit systems are eliminated; toilet maintenance is easier for flush toilets. However, septic tanks require periodic emptying, a task that presents challenges similar to those encountered when buckets must be emptied. Extracted sewage must be dumped in a safe place. This is true in Noordoewer, where an appropriate dumpsite is still being sought. The original settlement dumpsite for sewage and refuse was closed, in part because poles from the fence protecting it were stolen. The settlement officer has identified a new, temporary dumpsite, but needs help to find a truly satisfactory method of sewage disposal. In Karasburg, where sewage disposal was not identified as a problem, officials still feel that the process of emptying septic tanks is very labor-intensive and will become increasingly expensive as fuel prices rise.

Sewerage systems present very few immediate problems. In terms of use and maintenance at the user level, there were no problems reported. The two areas where difficulties do exist are in the construction of such systems and in the larger water supply

upon which they depend. Nearly every local authority and Community Development Committee member whom we interviewed described a sewerage system as the ultimate goal for the area. However, funds for construction are often lacking, and when construction is initiated, it does not always result in a working system. Klein Aub has used septic tanks in the village from the time when the local mine operated. Since then, a modern sewerage system has been built, but a member of the local Community Development Committee described the system as functioning so poorly that the older septic tanks are still being used. In Bethanie, residents in the informal area (which currently uses the bucket system) would like to connect to a sewerage pipe that runs nearby, but the settlement plots are arranged in an irregular way that is not amenable to the construction of a conventional sewer system. These roadblocks to the construction of sewer systems have stalled sanitation development in areas that see a sewer system as the best way forward.

A less immediate but acknowledged issue with conventional sewerage systems is their reliance upon a large amount of water in such an arid region as the FRB. None of the local authorities we interviewed reported current problems obtaining enough water for their sewerage systems. However, serious problems do exist in recovering the cost of this water from residents who use the system. Martin Harris, whom we interviewed at NamWater's Windhoek office, also explained that payment for water is the only current concern he sees about upgrading to conventional sewerage systems. Yet, payment for water is a large problem in many urban areas, as explained in Section 4.3. Payment problems aside, both Karasburg and Noordoewer expressed frustration at not being able to obtain enough water for projects in agriculture or manufacturing, and any significant upgrade to a water-intensive sewerage system may bring up the same issue. Moreover, given the nearly universal intention of bringing waterborne sewage systems to the urban areas of the FRB, the water supply may very well eventually become a much larger issue when a larger proportion of the population is using water-dependent sanitation methods. This problem could be compounded in the south by the reduced flow expected in the Orange River in the next five to ten years as mentioned to us by the regional planner of the Karas Region.

The vacuum system is present in only one of the urban areas that we visited (in Gibeon), and local officials told us that it is working well. However, officials did not have a clear idea of how much it would cost users to connect to the system. It is also unclear whether or not this modern system will benefit Gibeon's informal settlement, where the bucket system is currently being used. Additionally, while vacuum systems are capable of

transporting waste using less water than conventional sewerage, Gibeon's system will use conventional toilets that use just as much water as those found in conventional systems.

4.2.3 NOTABLE SUCCESSES IN SANITATION

Successes in sanitation are more difficult to identify than problems in sanitation. We did observe many completed sanitation projects that will be to the immediate benefit of many people, but the long-term sustainability of such projects is a more complex issue that to some degree lies beyond the scope of this assessment.

Leaving the long-term outlook aside, the most obvious successes are in Keetmanshoop and Karasburg, where most households have individual access to a septic or sewerage system, including many in the informal areas. In Keetmanshoop, these toilets are connected to the municipal sewerage system. In Karasburg, the informal areas actually have a more modern system than the formal areas; the informal area was connected to a sewerage system in order to replace the very problematic bucket system there, while the formal area is still using septic tanks. In both municipalities, it is likely that some users are not availing themselves of these services, either because their water service is shut off for non-payment or because they cannot afford to build the facility required to connect to the system. The latter is generally not a problem in Karasburg, however, because the sewerage upgrade in the informal area was funded by the European Union, which provided brick outhouses for each erf (plot) as shown in Figure 17.

FIGURE 17: EXTERIOR AND INTERIOR VIEW OF TOILET IN THE KARASBURG INFORMAL AREA

Note: Leaking water beneath the toilet in the right image suggests that maintenance of these toilets is not complete. Leakage will raise the water bill of the user and raise the overall water use of the municipality.

These successes in making a modern sanitation method available to so many residents are partly due to the fact that, as municipalities, Karasburg and Keetmanshoop have more resources than other, smaller locales. In Keetmanshoop, however, the success may also be partially due to the characteristics of the current interim CEO, Patrick Hamann, who is also the city engineer. His background in industrial and civil engineering is uncommon in an executive, and during our interview he explained that his understanding of infrastructure projects on a technical level has helped him to guide such projects to success. The potential problems with water-intensive sanitation methods notwithstanding, the level of sanitation provision in Keetmanshoop and Karasburg is a notable achievement.

4.2.4 TRENDS IN SANITATION DEVELOPMENT

During our fieldwork, we saw what seems to be a clear hierarchy of sanitation methods being used in the FRB. Flush toilets connected to a sewerage system (vacuum or conventional) are taken to be the best available method by planners, followed by septic systems, pit toilets, buckets, and bush. The only lateral deviations from this scheme are in Maltahöhe and Mariental, which are looking to run pilot projects with the Otji Toilet, and Keetmanshoop, where dry sanitation toilets are used at the golf course and at a woodcarvers market. In no case is an alternative sanitation method being used on a large scale or in a way that is integrated into a larger plan for resource management.

The strongest overall trend that we observed in sanitation development is a desire to move towards waterborne sewerage systems. Without exception, every local authority, Community Development Committee member, and regional official described some sort of modern sewerage system as the ultimate goal of every development plan. Keetmanshoop has largely reached the goal of providing waterborne sewerage connections to most residents, and Karasburg is close behind. Bethanie has acquired funding of N$6 million over the next three years to install a sewer system to replace the bucket system currently used there. Tses has also obtained N$3.3 from the National Planning Commission to install a sewerage system in the informal area there. The regional planner of the Karas Region explained in an interview that conventional and vacuum sewerage systems are planned for every settlement under regional management, although vacuum systems are favored because of their potential for water conservation.

Authorities we interviewed occasionally mentioned dry sanitation as well. In Keetmanshoop, dry sanitation is used to conserve water at a golf course and to provide

sanitation for souvenir-sellers who work beyond the reach of the municipal infrastructure. The planner for the Karas Region described a dry sanitation toilet being used in a very small pre-settlement area. If successful, it may be used in settlements, but only as a temporary measure until a waterborne system can be installed. Both Maltahöhe and Mariental are planning pilot installations of the Otji Toilet (described in Section 2.7.1). In the past, when Gibeon ran a pilot of the Ecosan, users rejected it. Maltahöhe and Mariental expect to encounter some resistance to the Otji Toilet, so they are seeking interested volunteers to receive them in the hope that a successful pilot will change the minds of other residents. Noordoewer is currently awaiting the installation of VIP toilets to replace the bucket system used there, a project complicated by the risk of contaminating water in the nearby Orange River.

Communal sanitation facilities are uncommon in the FRB, and many local authorities disliked them as a rule. In fact, the only two instances of communal sanitation we observed – communal pit toilets in Grünau, and communal buckets in Bethanie – were not planned by the local authority at all. These facilities seem to be the result of a lack of resources among people who would rather have their own, private facilities. Many local authorities echoed what we heard from Dr. Andreas Wienecke at the HRDC in Windhoek: that communal facilities often flop because users lack the incentive to maintain them. In Maltahöhe, where two example Otji Toilets are to be installed, the CEO has decided to place them in private households to ensure that they be properly used and maintained. He told us that he is generally not in favor of communal facilities. Patrick Hamann, the current CEO of Keetmanshoop, opposes communal sanitation facilities for this reason, but also because he feels that they are an indignity for those who must use them. Multiple local authority officials described the scenario in which an elderly woman is forced to walk from her home to the communal facility at night, when both darkness and crime threaten her safety. The successful provision of private sanitation facilities to every erf in both Keetmanshoop and Karasburg suggests that communal sanitation may not be necessary in the basin, although the risks of wide use of water-intense sanitation methods may require that universal, private facilities be other than conventional sewerage connections.

4.3 TARIFFS & COST RECOVERY ISSUES

In this section of the report, we discuss what we learned about water and sanitation tariffs, cost recovery programs, and debt in the FRB.

4.3.1 WATER TARIFFS

Consumer water rates vary depending on location in the basin, distance from the water source, original quality of the water and the NamWater rates imposed on the local authority. In terms of charging customers, some areas only look to recover the cost of the purchased water, while others are hoping for a profit. Distance from the water source and the quality of the extracted water affect the NamWater tariff because of transportation and purification costs.

Figure 18 shows a comparison between what NamWater charges the local authority and what the local authority charges the consumers, per unit price of the water. For the purposes of this graph, and due to the lack of available data, the average between the prepay meter and conventional meter unit price was used for comparison. Note that the ratio between the two types of meters is not equal within each urban area and not all urban areas have both conventional and prepay meters. With the exception of Maltahöhe, consumer tariffs in the FRB are greater than what NamWater charges the local authority, yet some local authorities remain in debt to NamWater. Even if the local authority is not in debt to NamWater, all local authorities receive insufficient funds from the community members. It should be noted that selling water at a greater price than it is bought for does not guarantee that a local authority's water system as a whole is profitable if the cost of infrastructure operation, maintenance and administration exceeds profit from sales.

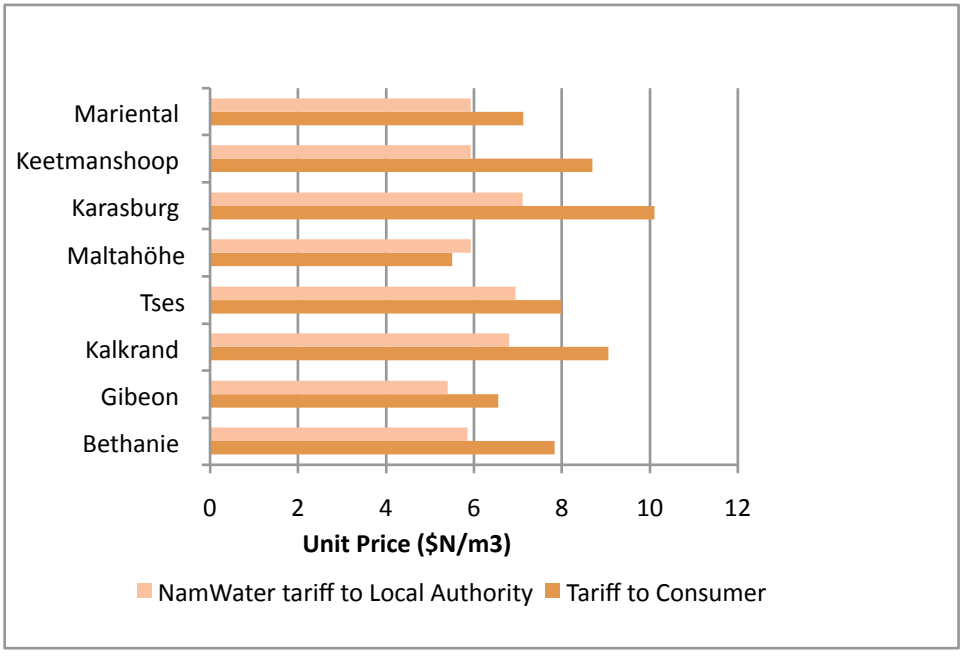

FIGURE 18: RELATIONSHIP BETWEEN NAMWATER TARIFFS & LOCAL AUTHORITY TARIFFS

Most local authorities are able to purchase bulk water from NamWater and sell to consumers on at least a cost-recovery basis, though there are exceptions to this trend. The Village of Maltahöhe sells the water for less than they pay for it and thus are operating at a loss. The CEO was concerned that with the increasing tariffs from NamWater, the citizens of Maltahöhe would not be able to afford the water. Until last year, Gibeon was also selling water at a loss, which suggests that the local authorities do not consider cost recovery a major priority. Unfortunately, if the local authorities are operating at a loss, debt accumulates and is perpetuated. For the most part, water from the conventional and prepay meters are similarly priced, if not priced the same.

Figure 19 shows the relationship between conventional meters and prepay meters in the urban areas that have both types of meters. In some places, the unit price for conventional meters is the same as the unit price for the prepaid water.

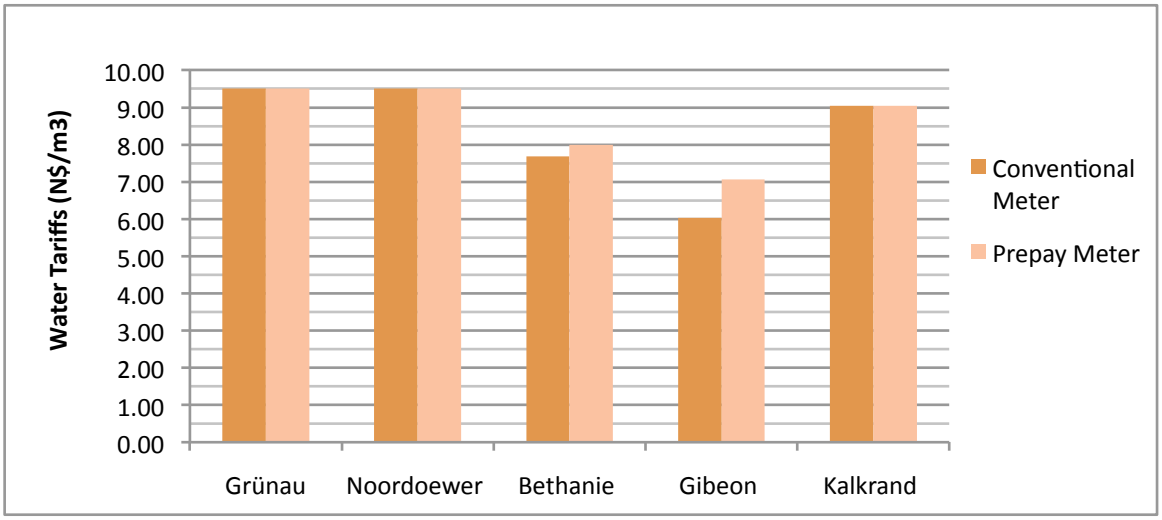

FIGURE 19: CONVENTIONAL METER & PREPAY METER WATER TARIFFS

Water users with conventional meters are sent a monthly bill, which includes the basic monthly charge and the cost of water consumed. Basic charges are included because they supplement the cost of water delivery and maintenance costs to the local authority and are collected regardless of water consumption. Basic charges for conventional meters are hard to justify to consumers, especially when communities have both conventional and prepay meters. Some local authorities consider it unfair, especially to pensioners who tend to have low amounts of water consumption.

In some cases, prepay water consumers are forced to pay a higher unit price for water. Often it is not clear to prepay users why their water price is higher than that for conventional meters. The prepay unit price in both Gibeon and Bethanie is higher than the conventional

unit price. The CEO in Gibeon suggested that this is because users with prepay meters do not pay a monthly basic charge and thus, must partially pay for it through the unit price. The discrepancy in prices could also be due to the fact that prepay meters are much more expensive than conventional meters.

Monthly residential basic charges for conventional meters range from N$17.00 to N$45.00 in the FRB, but the median price is N$28.00 – a much more representative value. Although we focused mainly on the residential use, businesses also use prepay and conventional meters but pay higher monthly charges.

4.3.2 SANITATION TARIFFS

As mentioned in Section 4.2.1 septic systems (French drains), conventional flush toilets, flush toilets with oxidation tanks, pit toilets, and bucket systems are used for sanitation. Costs to the user are relatively similar throughout the basin. The median of the monthly septic tariff is N$30. This monthly tariff pays for costs associated with the maintenance truck(s) and emptying the tanks. Each town has slightly different procedures when dealing with paying for waste management. In Gibeon, for instance, the consumer pays a basic charge, N$13.04 per month, plus an extra fee for each toilet in the household, N$7.82 per toilet, per month – similar to the conventional meter system presented above. In Bethanie, the user pays a monthly basic fee of N$20 plus an additional N$20 when the septic is pumped. In Karasburg, there is no basic monthly fee, but users pay a standard N$54 when the septic needs to be emptied. Septic tanks are emptied as needed depending on the urban area, size of the tank and the number of users.

One of the dry sanitation systems also has basic charges associated with removal of the waste. There is no monthly fee for the pit toilet because these systems are not emptied. In most urban areas there is a monthly charge to empty the buckets used for sanitation. In the majority of areas, the monthly bucket tariff is N$5. Some areas empty the buckets on a set schedule, while others only empty the buckets when the local authority is informed they are full. In some local authorities, the charge to remove the bucket is irrespective of how many loads and charged on a monthly basis, while others remove waste

4.3.3 AFFORDABILITY

In general the local officials consider prepay water affordable and on many occasions suggested that “everyone has $5 for (prepay) water”, but there are many factors that

contribute to affordability including past personal debt, past community debt, employment status, economic opportunities in the urban area and health. The Namibia Water Awareness Campaign (NAWAC) Report, referenced in Section 2.4.4, and the Participatory Poverty Assessment both suggest that water in the Fish River Basin is not affordable (NAWAC 2005; DRFN 2007b; DRFN 2007c). Many local authorities believe that conventional water (and electricity) meters are a root cause for the amount of debt accumulated by the consumers and accept prepay meters as a solution for cost recovery. With this system if users do not have money then they cannot use the water. Users generally like prepay meters for this same reason, as well as that fact that confusing basic charges are not tacked on to a monthly bill that they receive at the end of the month. The many urban areas have switched to or are in the process of switching to prepay meters.

In almost every urban area, when officials were asked why people were not paying their water bills, they answered that there were a lot of pensioners, the unemployment rate was high, and that there were not enough job opportunities in the area. Similar to what the NAWAC Report concluded, we found that due to the lack of employment opportunities in the areas, debt increases over time, and users feel overwhelmed by their debt. In towns with seasonal work, like Noordoewer, or in areas where there are farmers who are paid quarterly, like in Gibeon, consistent payment of water bills is a major issue because people do not have a constant monthly income. In many areas pensioners have serious issues paying for their water bill. Certain pensioners in Gibeon cannot afford to switch to prepay meters and are stuck paying a basic charge they cannot afford. In general, users understand the need to pay for the services, but they cannot afford them.

Nonpayment is also due to other reasons such as avoidance, lack of responsibility, misunderstandings, and empty promises from politicians. Sometimes users cannot pay, but some authorities mentioned that the low cost of water is detrimental to the payment programs because people do not take payment seriously. In the past payment has also been an issue because users did not understand why they needed to pay for water if there was a water source they could walk to. Statements from politicians promising free or cheaper water if they are voted into office are also detrimental to the water payment structure.

Another situation that complicates payment collection is when the infrastructure system is faulty or when there are upgrades. Ben van der Merwe, of Environmental Engineering Services (ENVES), recalls a time when Gibeon sold more water than they bought from NamWater. Higher sales rates than production rates suggest major infrastructure issues and meter malfunctions, and may explain why people have trouble

paying for water. In Grünau, when the system changed from conventional meters to prepay meters, customers with arrears assumed that their debt would be erased, and they still do not want to pay off the old debt. To avoid extra costs due to defective infrastructure, van der Merwe recommends replacing 2% of the pipes annually.

Water quality issues or the lack of water also influences the amount of debt in a community. In Klein Aub, people accrued debt by refusing to pay when the water was of poor quality and unfit for human consumption. From 1992 until 2002, NamWater classified the water in the area as Grade C and declared it unfit for human consumption. Many refused to pay for substandard water, and the local authority accumulated a lot of debt to NamWater. A member of the Settlement Advisory Committee said that when the water with soap in it stopped forming soapsuds, many locals moved out of town to find better water but left their debt behind. A member of the Settlement Development Committee suggested that individual debt should not be a community's responsibility, and believes that the debtors will either not be traceable because they have deceased or will not pay regardless of the settlement's demands. Because the community as a whole cannot subsidize all of the users who abandoned their debt, she believes the debt to NamWater should be written off.

The Keetmanshoop Town Engineer and acting CEO said that nonpayment in the informal settlement Illeni is virtually not an issue. Because the area lacked water for so long the community is eager to keep the service. Keetmanshoop utilizes a computerized financial system in which each new user is documented and combines water, sanitation, sewer and land hire costs into a monthly rent of N$135. A municipal officer specifically dedicated for the informal settlement educates users about payment and bills through community meetings to clarify misunderstandings and perpetuate the responsibility of payment.

By comparing Figure 20 with Figure 21, connections can be made between water use and the cost of water. As mentioned above, the employment opportunities in an area can greatly affect the affordability of municipal services. Noordoewer and Grünau use the least amount of water per capita and are charged almost the most per unit. For these two settlements, both with high unemployment rates and a plethora of seasonal workers, water is very expensive and unaffordable. Both local authorities mentioned that water was unaffordable to their users, and this data may help their case.

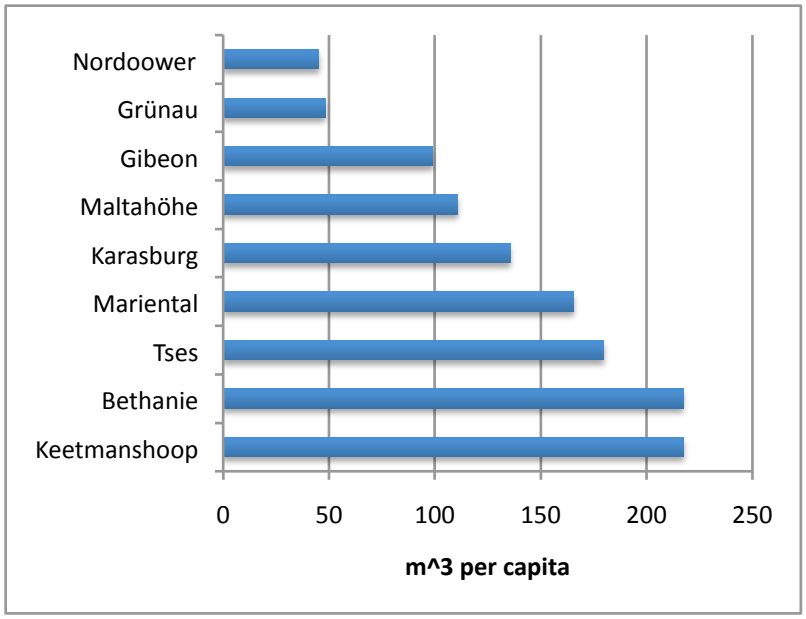

FIGURE 20: WATER PURCHASED PER CAPITA

Note: Data provided are from July 2005 until June 2007.

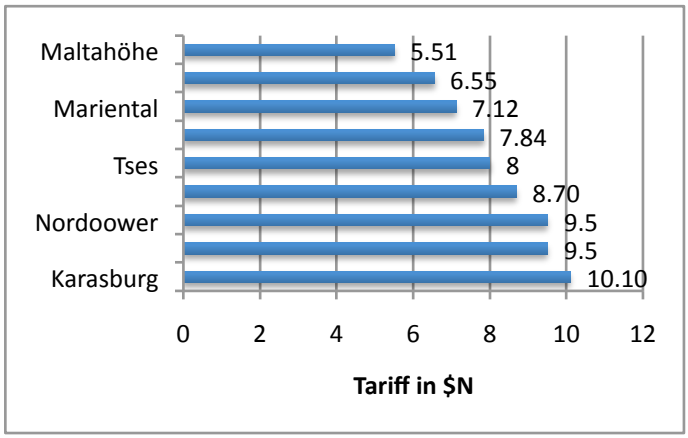

FIGURE 21: AVERAGE CONSUMER WATER TARIFF

Municipalities seem to be independent of each other in consumer tariffs, water per capita and perceptions about prepay and conventional meters. Table 10 compares the water tariffs and expected profit of each municipality. It is noteworthy to mention that each has mostly conventional meters in the area, but the perceptions about prepay and conventional meters range from genuine interest in Karasburg to pure animosity from the CEO in Keetmanshoop. Karasburg has the highest water tariff at N$10.00 per cubic meter and its water consumers use about 136 m^3 per person; about midrange for water users in the FRB, but lowest of the three municipalities. One reason for the higher tariff could be that

municipalities generally have a higher percentage of wealthy persons than in smaller villages and settlements and can afford more, on average.

The same should be true for Keetmanshoop and Mariental, but neither is fully capable of making ends meet. Mariental usually cannot collect enough from water bills to balance the water books, but can cross subsidize with electricity and other municipal services. Keetmanshoop is still recovering from a N$5 Million debt to NamWater. Currently the municipality owes N$800,000 but is actively collecting debt to pay NamWater with a negotiated N$100,000 payment per month.

TABLE 10: MUNICIPALITY TARIFFS

Municipality	NamWater (N$)	Tariff	Tariff to consumer (N$)	Expected Profit (N$)
Karasburg		7.10	10.10	3.00
Keetmanshoop		5.93	8.70	2.77
Mariental		5.93	7.12	1.19

Consumers in Bethanie use 217 m^3 per capita, but the water costs over N$1.50 over the minimum price. This could be a result of one of three reasons: the Bethanie village has been bailed out by the Ministry and is therefore not affected by the cost of water and debt accrued by not paying, there are significant leaks in its infrastructure or water is actually affordable. Considering the great emphasis on the fact that most people in Bethanie are unemployed and the high debt to NamWater (N$380,399.23) leakage is probably more realistic. However, if the water is actually more affordable, Bethanie has the highest ratio of prepay to conventional meters in the FRB (shown in Table 11) which supports the idea that prepay water meters are more affordable.

TABLE 11: CONVENTIONAL & PREPAY METERS IN THE FRB

Location	Prepay	Conventional	Ratio Prepay : Conventional
Noordoewer	90	130	0.69
Grünau	24	24	1
Gibeon	YES	YES	NA
Maltahöhe		186	NA
Karasburg	0	YES	NA
Mariental	90	2300	0.04
Tses	12	172	0.07
Bethanie	384	195	1.97
Keetmanshoop	0	3617	NA

Note: Where information on the number is unavailable there is a simple "YES" or "NO".

ND=no data. NA= not applicable.

Despite the fact that a correlation exists in Bethanie, a correlation cannot be made in the entire basin between the amount of prepay meters and conventional meters in the urban areas and the water tariffs imposed on consumers. Thus, whether prepay meters or conventional meters are present does not make the water more or less affordable.

4.3.4 BILL PAYMENT PROGRAMS

Each urban area collects from indebted customers in different ways and has different priorities. Some local authorities cut the water off after a time period of one or two months of nonpayment or after a certain amount of debt accumulates, while one area never shuts the water off, regardless of the amount of debt. A few locations charge interest, late fees or reconnection fees. All of these methods are considered cost recovery programs and should be treated as such.

Many authorities have strong payment protocols in place but do not always follow them, especially with pensioners. Other authorities have systems in place, but no set protocol about how sanctions should be decided. In Mariental, water is supposed to be shut off if there is a nonpayment issue, but a pensioner's water is never turned off. In Gibeon and other smaller areas the local authority works on a "personal credit system" where negotiations can be made to pay less than the actual amount on the bill for a short period of time. In

Noordoewer, Tses, Karasburg, and Kalkrand there is a reconnection fee if the tap is turned off. Gibeon has been forced to use electricity as leverage to force people to pay for their water bills because many citizens went for years without a connected water tap, refusing to pay.

Bethanie and Kalkrand have unique payment programs for citizens who owe large amounts to the local authority. All communities agree that water is basic to human life, and they do not believe in depriving citizens of water. However, they also realize that there should be repercussions for not paying the water bill. Bethanie has a system whereby indebted community members are hired to work on community projects for the Council. This system provides beneficial job opportunities and helps unemployed workers pay off arrears. Kalkrand turns large amounts of debt into loans for indebted citizens so they can still receive the water service. The loans accrue interest, and there are late fees if the associated payments are not paid on time. Kalkrand also turns off the water to highly indebted citizens, but turns it on at certain times of the day so the consumers still have access to water, although it is not as convenient.

Karasburg is perceived to have the strictest payment schedule and seemed to have the least difficulty with large amounts of debt from consumers. Every water user is held accountable for his or her water payment. Bills are sent out to the water users on the 25th of each month, and users have until the 15th of the next month to pay. If they do not pay on time, a late fee of N$5 is added to the bill. If the user still has not paid by the 21st of the next month, the water tap is turned off and there is a reconnection fee of N$60.00. Reconnection fees are not unheard of in other areas, but Karasburg's schedule has specific dates and is impartial to its users. Tses has a similar system of cutting off water after one month, but often the deadlines are extended. Similar to other urban areas, one-on-one negotiations are sometimes used when the tap is turned off and payment plans are discussed before the water tap is turned on.

When payments cannot be made, all of the urban areas engage in negotiations with their clients to ensure that the user is getting water and the local authority is getting paid. No one is mean-spirited or curt about collecting payments, and generally the local authorities empathize with their community members' problems. This may be where some of the leniency in paying bills in a timely manner comes from. It is not that the authorities do not care about cost recovery; it's just that in such small areas, the communities act as a family of tight knit people. Nevertheless, authorities agree that municipal service payment is a major issue that needs to be resolved.

4.3.5 CHANGING TARIFFS

Through interviews with local authorities, we acquired basic knowledge about the process through which tariffs are increased. First, NamWater officials budget the increase and present it to the Ministry of Agriculture, Water and Forestry for approval. After the Ministry approves it, the tariff goes into effect at the beginning of the fiscal year, in June. Often, the local authorities do not know about the tariff increase and cannot respond in enough time to increase the tariff to their consumers. This produces problems because for periods of time local authorities are bringing in less revenue from water services than they must pay and are operating on a loss. If the local authorities wish to increase their tariffs, they have to wait until budgets are submitted to the Ministry in April. These processes often take long periods of time, and during this time the local debt to NamWater grows and forces the local authority to find other ways to subsidize the cost of water.

Most areas dislike this system and believe that they should be contacted well ahead of time so they can prepare for the increased tariff. This preparation could help the authorities take the necessary steps to increase their tariff so they do not lose money. Educating community members about the change before it happens may help reduce some of the shock and animosity against the local authority. To help prepare the citizens of Bethanie, the Village Council and Community Development Committee meet together before presenting the tax increase to the community.

Most local authorities also mentioned the frequent NamWater tariff increases. Karasburg has tried to combat the increases and protect water users by absorbing 5% of every 10% NamWater tariff increase for a short period of time after the change. This system may be difficult for smaller areas, but the Karasburg municipality can afford the subsidization on a short-term basis because they have an effective bill payment program in place.

4.3.6 DEBT TO NAMWATER

Due to the inadequate payment recovery strategies in the urban areas, many urban areas are in debt to NamWater. At times NamWater has to threaten to cut off the water services to entire areas to get them to pay the past arrears. Each classification of urban areas (settlement, village, and municipality) has a different financial relationship with NamWater. Settlements are under the jurisdiction of the Regional Councils, therefore the Regional Council is responsible for the payment to NamWater. Settlement Officers collect payment from the users and send it to the Regional Council. Of the urban authorities in the basin, villages have

the greatest issues with payment to NamWater, and many have been threatened by NamWater that the water will be turned off to their village if payment is not received. Municipalities are more independent and have stricter payment schedules. As a result, Mariental and Karasburg do not have any outstanding debt to NamWater. Table 12 lists the urban areas and their debt to NamWater.

TABLE 12: URBAN AREA DEBT TO NAMWATER (WHERE AVAILABLE)

Location	Classification	Debt to NamWater (N$)
Grünau	Settlement	0
Noordoewer	Settlement	0
Bethanie	Village	380,399.23
Kalkrand	Village	163,649
Maltahöhe	Village	470,000
Tses	Village	615,962.93
Karasburg	Municipality	0
Keetmanshoop	Municipality	800,000
Mariental	Municipality	0
	Total:	2,430,011.16

Sometimes upper levels of government intervene to help urban areas pay off arrears. Last year NamWater, NamPower and the Ministry of Regional and Local Government, Housing and Rural Development (MRLGHRD) met and discussed the arrears of several Village Councils. In the assessment, they took action in Bethanie, and the Ministry paid off N$917,540.07 in past arrears as of May 2007. Bethanie's current overdue balance is N$380,399.32, and NamWater is threatening to take further action. A similar payment situation has happened to Tses and Kalkrand. The Ministry paid off all old arrears, but the Village Council did not improve its bill collection methods so debt has accumulated again, and NamWater is once again threatening disconnection. Clearing the debt has not seemed to help the villages, because no changes are made to the bill collection and cost recovery programs.

4.3.7 COST RECOVERY

There have been a few successful cost recovery programs in the basin. Grünau had a policy at one point of refusing prepay token recharge unless customers paid off a small

portion of their past conventional water meter debt. The system worked to recover costs but has been stopped because community members complained too much. In December 2007, the Maltahöhe CEO sent out letters to water users to demand payment for arrears, and the local authority received over N$50,000 in one week. The Rehoboth project explained in Section 2.4.4 provides a great example of the power of persistence in debt repayment. Although not within the FRB Rehoboth is also a good example of how block tariffs can be used to cross subsidize water users within the program. The FRB is not currently using any block tariff systems except in Mariental where a block tariff system is in place for businesses in the municipality, but not used as a cost recovery system.

Often it is necessary for the local authority to find other ways to subsidize or to make payment plans with NamWater when they cannot collect enough from the users. The Mariental and Karasburg Town Councils often use revenue from electricity and other municipal services to cross-subsidize the payment of water. This explains why they do not owe NamWater anything, but can still come up short in their annual water budget. Similarly, in Gibeon, the authority has used capital development funds to subsidize the water bills, so the village is not able to focus on development. Keetmanshoop was deep in debt to NamWater but negotiated a payment plan and is actively working on repaying their debt. The municipality was in arrears N$5 million and has been paying N$100,000 monthly to NamWater. Since the start of the repayment plan, the debt has decreased to N$800,000, which shows that, through persistence, large amounts of debt can be paid off. Quantitative data about exact water and sanitation tariffs and volumes of water supplied by NamWater to the local authorities are presented in tables in Appendix E: Quantitative Data.

4.4 MANAGEMENT

The management of water and sanitation is the responsibility of the local authorities in the villages and municipalities. In the settlements, a settlement officer who is an employee of the Regional Council oversees this responsibility. The Constituency Development Committees control different areas in the basin. They are responsible for monitoring construction projects. Construction projects are chosen that have been requested by the community and approved by appropriate Ministry. The Constituency then chooses the process for implementing these projects and monitors the construction. They are not involved in the management of water and sanitation, only the development of new infrastructure and sanitation systems in their jurisdiction. In most urban areas there are management issues

relating to record keeping, communication and a high turnover rate of staff in the local offices. It was also found that there were strong feelings about management on a basin level.

4.4.1 RECORD KEEPING

In addition to meeting with stakeholders in the basin we also requested quantitative data from the local and regional authorities. These data included the following:

- Volumes of water supplied to the local authority by NamWater for a period of one year, broken down by monthly volumes
- Volumes of water supplied by the local authority to consumers for a period of one year, broken down by monthly volumes
- Tariffs that consumers pay for water and sewerage, including business customers;
- The difference between the accounts that the local authority sends out per month and what the consumers pay
- The total outstanding debt that consumers owe to the local authority
- The total outstanding debt that the local authority owes to NamWater
- Night flow between 02h00 and 04h00 in the morning
- Number of prepay and conventional water meters

These data were difficult to obtain, and only 1 out of the 11 urban areas visited was able to supply us with the full set of data that we requested (excluding night flow). The one urban area that was able to supply the data was Karasburg. We believe this is due to the fact that the treasurer had been there for thirty years and had a regimented record keeping system. Our failure to receive the data was not due to the unwillingness of the local authorities to supply them. In all cases the local authorities put in the effort to generate the data, but in the end these data could not be produced in an acceptable timeframe for our study. The most difficult data for the local authorities to compile were the volumes of water supplied by the local authorities to the consumers on a monthly basis, the total outstanding debt that consumers owe to the local authority, and the night flow volumes. Most urban areas that could provide a figure for the outstanding debt owed to the local authority could only provide a value that included debt for all services. While it is disappointing that this report could not include these data, it does lead to an important finding.

All the urban areas visited have different methods of record keeping. It was apparent that many of the methods utilized are personalized to the individual in charge of keeping the data. From our observations this was the situation at the settlement offices, where the

settlement officers are not provided with a standardized format in which to submit their data to the regional councils. Some of the record keeping is still not computerized and requires that calculations be done by hand, a time consuming process. With the introduction of the prepay water system, settlement officers are required to learn to use the software supplied with the meters. Complicating the record keeping system is that most settlements are using both conventional and prepay systems. Conventional meter readings must be recorded in a different manner, requiring two separate record keeping systems for the different types of water meters.

Settlements are directly administered by the Regional Councils. The settlement offices are in charge of collecting revenue for water and sanitation services that are supplied to their residents. This revenue is reported monthly and sent to the Regional Council. Because of this system the settlements are not aware of the amount of money that is owed to NamWater for bulk water supply, and therefore they do not know how much money they should be collecting in order to fully recover costs. Ideally the cost of the water supplied should be fully recovered and paid to the bulk water supplier, but when issues such as nonpayment, water loss, and infrastructure maintenance are factored into the cost, this is never the case. Settlements are having a difficult time managing their problems because they do not have access to the quantitative data to analyze what their problems are.

In the case of the Village Councils and the Municipalities, they are using an accounting program known as Finstel Financial Systems. Based on our observations it was evident that Finstel is not very user-friendly. This program was able to provide the volumes of water supplied to the users, but it required printing out entire statements for each month to do so. Also, each statement took even an experienced employee at the local authority time to decipher what the values represented in each column.

The problems of record keeping are compounded by the fact that there is a high turnover rate of officials. In Kalkrand there was an interim Chief Executive Officer (CEO) who was contracted for a period of three months. The previous CEO resigned after a period of 3 months. Within a one-month period three new personnel were hired at the Kalkrand Village Council. This is not an isolated incident. There are similar situations all over the FRB. In Gibeon a new CEO is appointed every six months. The CEOs are selected from the Village Council and rotate the position among themselves. The idea behind this method is that multiple people are trained for the position of CEO. In Maltahöhe the CEO has been in office for six months. In Bethanie a consultant was hired for a period of six months to assist with outstanding matters. It was found that corruption around the year 2000 had led to the

loss of many records. Because local officials are serving for such short terms, it is difficult for officials to become acquainted with the record keeping system. With no standardized record keeping system the data that we requested either does not exist or could not be located in many of the urban areas.

To improve record keeping and accounting funds have been set-aside for Regional Councils to employ a statistician. Areas such as Noordoewer are desperate for personnel training in order to improve their accounting and revenue collecting systems. One of the problems mentioned in that particular settlement was that when an accounting mistake is made in billing or other areas it takes a long time to find the mistake and then time to find the correct values. Other urban areas such as Grünau reported that they would like to receive more training as well, particularly with the prepaid water meter software.

Inefficient record keeping and accounting leads to lost revenue and difficulty on the part of the local officials to quantitatively and consistently address issues that are occurring in their urban areas. Without easily accessible data about the volumes of water supplied to the consumers, the local officials are not able to determine the water loss in their infrastructure or trends in water use. Values such as the debt owed to local authorities by consumers for water is a good indicator of how effective their cost recovery system is. In Maltahöhe, the CEO explained that they did not have a finance officer and that being an understaffed authority has put limits on the size of projects that can be carried out without outside help from ministries or other local authorities. Efficient and transparent record keeping leads to a well-run local authority that can focus its energies on development.

4.4.2 COMMUNICATION WITHIN THE FRB

During our field expedition we observed and gathered perceptions about communication existing at all administrative levels of the basin. The communication channels that were most obvious as either being lacking or strongly in place were those between NamWater and local and regional authorities, between settlements and regional offices, and between local authorities and community members. We found no communication between the Hardap and Karas regions about water, sanitation or other issues. This may be indicative of the fact that decentralization has not fully taken place. Although the government has undertaken steps to empower the people in their political structure through basin management committees and decentralization as discussed in Section 2.2.2, we

did not find evidence that this was taking place on a meaningful level whereas the authorities had the resources to solve their community problems.

It is difficult to make generalizations about the relationship of NamWater with the local authorities as it varied between the customers. Overall the urban areas spoke positively about NamWater and were happy with their bulk water provider. So even though many of these Councils were holding letters from NamWater which threatened to disconnect the water if they did not make payment.

Communication between local authorities and NamWater seems strong and regular. Noordoewer reported that NamWater was quick to respond to their concerns. Gibeon reported having quarterly meetings with NamWater. Tses is in negotiations with the MRLGHRD and NamWater for the funding of a water purification plant, and also stated that meetings with NamWater occur when problems arise. The CEO of Keetmanshoop reported that his relationship was very good with NamWater. Because of his engineering background he can communicate easily with the technical experts there. Those personal relationships foster a positive working relationship between NamWater and the Municipality. Other urban areas were also requesting help from NamWater for upgrades of their water distribution systems as well as help with cost recovery. NamWater has been hesitant to take on these types of projects however, because it would require a large financial investment.

Communication between the Settlement Offices and the Regional Council is not effective. According to the settlement offices under the Karas Regional Council they are not receiving the support that they need from the Regional Council. The Regional Council was shown to be slow to respond to maintenance requests. For example, in Grünau the settlement officer requested replacement water meters over two months ago but the Regional Council had not responded to this request at the time of our interview. Because of this the Settlement Officer has been forced to estimate the amount of water being used at the residences with broken meters, which is unfair to these consumers and complicates accounting and cost recovery procedures. Noordoewer has been promised a budget for training from the Regional Council, but it has yet to be delivered. The major form of communication between the settlements and the Regional Councils comes in the form of monthly revenue reports submitted by the Settlement Officers to the Regional Council. Both Noordoewer and Grünau reported that they do not have access to data such as the volumes of water that NamWater supplies to the settlement. They reported that they would like to receive these data when they are sent to the Regional Council. The Hardap Regional Council reported that the settlement offices submit monthly reports as well as special reports and needs assessment forms. We

were unable to meet with the settlement officers at any of the settlements under the Hardap Regional Council, so we are unable to report on the frequency and quality of their communication with the Regional Council.

In almost all urban areas that we visited, the local authority scheduled some type of regular community meeting. However, in most places these meetings are not taking place as regularly as they are scheduled to. This is the case in Mariental where community development committees are having meetings twice a year instead of quarterly. In Grünau, there are community meetings at which residents have the opportunity to share their complaints, but the settlement office lacks the resources to respond to them. The same problem also occurs in Noordoewer where meetings are taking place once per month. Common topics that arose during these meetings were the charges for municipal services, the lack of employment opportunities and sanitation. Community members are also able to communicate with local authorities by visiting their offices directly. For instance, the common way for consumers do deal with water issues is to go directly to their local settlement office, village council, or municipality office. In Keetmanshoop the mayor of the municipality has weekly office hours where people can come to air their grievances. As noted above, however, though there are channels for the community members to air their grievances, local authorities do not always have the ability to address the issues

4.4.3 PERCEPTIONS ON THE BASIN MANAGEMENT APPROACH

The general consensus in the FRB is that a basin management committee would be a positive addition to the area. Most local authorities were open to solutions for their issues from any source. Areas, such as Karasburg and Noordoewer, stated that a basin management committee would provide their communities the opportunity to learn from other urban areas. Katrina Cloete, the Settlement Officer in Noordoewer, mentioned a meeting she had attended in November of 2007 in which settlements in the Karas Region came together in Karasburg to discuss ideas and share information. She believes that a basin management committee could provide a similar forum. Other places such as Keetmanshoop saw their role in the committee as a model or information resource for others to look to in terms of solving water and sanitation issues. Mariental would like to be a key player in the management of water from the Fish River and the Hardap dam. Most local officials were able to identify their communities' roles in a basin management committee, as well as what they would like to gain from being involved. In Tses, the chair of the Village Development Committee stressed

that a basin management committee would be especially useful for smaller urban areas where the requested assistance is not always available. Overall, the feeling at the grassroots level was that any type of education or support that a basin management committee could offer would be accepted.

Stakeholders used the topic of a basin management committee to comment on areas that need improvement within the basin. In Maltahöhe, Noordoewer, and Gibeon the local officials stressed the need for education on all levels. In Gibeon, Councilor Samuel Karigub stated that the community does not yet understand the environmental issues faced by FRB residents or how they will impact them. Community education is therefore essential for a decentralized management system to operate effectively. A suggestion was also brought up that community officials must first fully understand the issues before they attempt to educate the community. In Kalkrand and Karasburg, officials talked about the long-term opportunities and sustainability of the water sources. The Karas Regional Council believes that a basin management system could work well in the FRB, because the region is homogeneous demographically and topographically. They also see the basin management committee as a resource because it would assist in the detection of community demands for projects. Projects that are in response to existing community demands tend to be more successful.

While most places in the basin are supportive of a basin management committee, some people have doubts about the actual feasibility of implementing a basin management system. The community development committee member interviewed in Klein Aub is hopeful about the basin management committee, but explained that when the government is brought to the people, it is like the blind leading the blind. Decentralization, as a political policy, would be more beneficial to larger areas such as Gibeon and Mariental, where resources would not be diluted so much as to render them useless. In the opinion of Piet Heyns, a civil engineer and associate of the DRFN, on a political level the process of decentralization can work, but technically it is hopeless. Decentralization dilutes technical skills and effectiveness. The sentiment at NamWater was the same: that with only a core group of specialized and technically trained people, it doesn't make sense to spread them out, especially in areas with a low population density. Andries Kok, the area manager of the Karas Region at NamWater, believes that people do not recognize the importance of water. NamWater is attempting to refocus and look at the country as a whole as opposed to region by region.

Many of the experts felt that sanitation could be more effectively decentralized than water. The deputy director of the Ministry of Health and Social Services would like to see sanitation managed at a local level, because the local officials are the best ones to approach the community with new ideas and plans. From an engineering point of view, Piet Heyns stated that sanitation systems are less complicated than water systems, and therefore it may not be as difficult to maintain systems at a local level. Dr. Andreas Wienecke of the Habitat Research and Development Centre suggests that systems such as DEWTAS (Decentralized Wastewater Treatment Systems; described in Section 2.7.1) are an example of a decentralized treatment system that can be built using basic skills.

Although not everyone is convinced that a basin management system will be effective, most people interviewed, especially those in the FRB, are open to any sort of education or support that can be provided.

5 CONCLUSIONS & RECOMMENDATIONS

Through our research, we have developed the following conclusions and recommendations addressing the water and sanitation issues we have observed in the Fish River Basin (FRB). Our recommendations are based upon successes we have noted in the FRB and elsewhere, and on the particular concerns that were expressed to us during our fieldwork by stakeholders in the basin. They include enhanced management and communication strategies, suggestions for revenue creating opportunities, methods of increasing the sustainability of water resources, and ideas for joint ventures among stakeholders in the FRB. If these recommendations are followed, they should lead to a more informed and empowered Basin Management Committee.

5.1 RECORD KEEPING AND ASSESSMENT

In order to establish a productive basin management committee an agreed upon and transparent record keeping system must be used in the basin. As noted in Section 4.4.1, the record keeping in many of the urban communities visited was not standardized, and information was difficult or impossible to obtain. Before a good system of records can be implemented the types of data that are important to have access to need to be determined. At the very minimum these data should include the volumes of water received from NamWater, the volumes of water supplied to the community, the outstanding debt owed to the local authority for each service provided, and the numbers of meters and sanitation systems in the area. The urban areas in the FRB need to be committed to keeping thorough records and to being regimented about keeping a proper filing system for these records.

A pattern of good record keeping will help to ensure that, as public servants come and go from the office, the standard of record keeping is maintained. The method of record keeping must be documented in a set of instructions so it can be followed by future employees. As record keeping moves into the digital age, local authorities need to create a database that will store and retrieve their information, thereby reducing the amount of space that records take up in the local offices. Local authorities already provided with computer programs, such as Finstel, should request training so that these programs can be utilized to their full capacity. In addition, training should be provided for all functions related to accounting and billing.

In order for the settlement offices to keep better records, they must be supplied with quantitative data from NamWater or from the Regional Council about the volumes of water that they are receiving, as well as other quantitative data that would enhance their ability to make decisions. These data will also help the settlement offices determine other values that will indicate the effectiveness of their cost recovery system and how well their infrastructure is being maintained.

To better assess how well local authorities are operating, a set of quantitative performance indicators should be established. These indicators should include the data mentioned above that are kept in the record keeping system. From these data, the volume of water loss, the percentage of costs recovered each month, and debt owed to the local authority can be extracted. These data can assist in the identification of problems, provide a method for documenting improvements and failures, and will allow officials to set measurable goals. The local authorities will have the ability to compare their performance with other urban areas or compare their own performance over designated time intervals. The performance indicators will be a valuable tool that can be used for checks and balances, but they will also allow future studies of the area to occur more easily and thoroughly.

5.2 COST RECOVERY

After reading the NAWAC Report and making conclusions about our own research, we concluded that delinquency between NamWater and communities could only be resolved through efficient intra-community cost recovery systems. Problems such as water quality, maintenance of the infrastructure in the region, as well as social misperceptions about government promises, and the level of poverty which occurs in the South, all must be properly addressed in confronting cost recovery. Education and training are most likely the easiest and perhaps the most important solutions to combat some of these issues, especially concerning people's perceptions. Sustainable basin-wide water management system for the Fish River Basin will depend on each urban settlement's ability to fairly and consistently pay for their water services. As such, **each urban area should budget for the expected tax increases imposed by NamWater so as to reduce the need for subsidization with other municipal services or development funds.**

Local authorities should be regularly educated and updated about effective cost recovery systems and should, in turn, communicate the importance of payment to the consumers. When users do not pay for services provided, the local authority's debt

accumulates. Regional newsletters, such as those instituted in Rehoboth, will provide a good example of how to effectively communicate the importance of paying for water and other municipal services with the community. In terms of nonpayment by the water consumer, specific protocols should be put in place and consistently followed. In Maltahöhe, letters were sent to debtors demanding payment for arrears, and the local authority collected over N$50,000 in less than a week. The repercussions to individuals and the community for non-payment should be made clear to water consumers. Detailed clarifications of the basic charges and explanations for increases in tariffs must outline to the consumer exactly what services they are paying for. With increased consumer awareness, consumers will be less reluctant to make payments. If each settlement, village and municipality took these steps to recover the costs of providing water, users would find more value in paying on time and respect the payment protocols in place.

Local authorities should consider other payment plans to help consumers manage water usage and bill payment. Combining arrears and bill payment has been successful in Rehoboth and may also be useful in the Fish River Basin. By negotiating with the users to pay a basic monthly fee for debt payment, the user can determine a feasible payment scheme and will be more likely to stick to the plan. Measures such as utilizing the increasing block tariff system may also be plausible in the Fish River Basin, especially in the Hardap Region, where the most glaring problem in achieving cost recovery seems to be poverty. Other programs, such as the one presented in the informal settlement of Keetmanshoop, where the water tariffs are combined with the other municipal services such as sanitation, refuse removal and property rental have been effective. This program promotes responsibility because if one service is not paid for then all are cut off. In the Fish River Basin, payment plans are necessary to promote user accountability for the water used and debts accumulated, and will provide the local authority with a standardized system of which to follow for bill collection.

5.3 COMMUNICATION

To facilitate a basin management committee, channels should be developed through which stakeholders can easily communicate with one another. This will create opportunities for local authorities and stakeholders within the basin to share ideas and discuss issues on a frequent basis outside of the stakeholder forums. Some of the benefits of this kind of communication would be seen in the form of integrated pilot projects between areas

in the basin, sharing of successful cost recovery strategies, and increased awareness about water management and conservation within the basin.

This communication could come about in many forms. A stakeholder newsletter could be generated in which happenings particular to the FRB could be presented. These articles would be most beneficial if the stakeholders write them about issues or projects in their urban area. The newsletter could be distributed between stakeholder forums to maintain interest in and awareness of the project. In addition, a list of stakeholder contacts could be distributed, allowing a local authority that wants to know how other local authorities are dealing with an issue to contact them directly.

A BMC could be a powerful platform for communication with service providers and government agencies. As described in Section 4.4.2, many local authorities face difficulties getting the attention of organizations that can assist them – NamWater, regional government, central government, and other service providers. The implementation of a BMC would help to alleviate this problem. This is because a BMC made up of many different stakeholders will naturally wield more political power than any individual stakeholder, and communication with such a body will be a higher priority for other organizations. For example, the regional planner of the Karas Region stated during our interview that a BMC would be useful for identifying projects that have broad community support. Such projects are attractive to the council, because they are more likely to succeed.

Communications channeled through a well-formed BMC will also benefit from the wide range of knowledge and experience reflected in such a committee. For instance, a local authority requesting new development can make a stronger case for the feasibility of the proposed project by relying on examples and opinions from other local authorities and stakeholders. For these two reasons, a BMC has the potential to enhance all stakeholders' capacity to communicate with external organizations.

Knowledge about the current state of water resources needs to be spread throughout the basin. Although local authorities and stakeholders are concerned about the sustainability of their water sources, they lack the information necessary to judge the long-term effects of their actions. Persons with knowledge of the geohyrological state of the region should be invited to join the basin management committee, in at least an advisory capacity. With access to this technical knowledge, local officials can make informed decisions regarding new projects in sanitation, water infrastructure, or other water-related projects. Through education, sustainable resource management can be promoted throughout the basin with a set of hard data to back it up.

5.4 COLLABORATIVE PROJECTS

Cooperative approaches to pilot projects could provide many benefits. During our fieldwork, we discovered that both Maltahöhe and Mariental are seeking to conduct pilot projects with the Otji Toilet. The two local authorities are confronting similar issues of user education and communication with sponsoring agencies, yet we saw no evidence that the two authorities have been working cooperatively on these projects. If two local authorities were to conduct the same project in their respective areas, discussion of the preparation and implementation of such projects could provide valuable ideas and insight to the participating authorities - and to others within the basin if the communications were made public. However, an even stronger benefit may be obtained if projects are conducted from a basin-level perspective. For instance, some pilot projects could benefit from duplication in multiple areas throughout the basin, by which means a sanitation or water management method could be tested across the range of social and geophysical conditions that exist in the basin while distributing the cost of experimentation across participating authorities. Conversely, some projects that would otherwise be duplicated – like the Otji Toilet pilots in Maltahöhe and Mariental – might benefit from being purposefully varied. In this way, a similar amount of resources could be used to test multiple solutions instead of just one. A BMC would be an ideal platform for the planning and coordination of such collaborative projects.

Even when only a single project is conducted in the basin, all stakeholders could stand to benefit from it. For instance, Ms. Niilenge, the current CEO of Karasburg, indicated to us that, while the municipality has the long-term intention of installing a conventional sewerage system in its formal areas, it would be open to the suggestion that a different option is more appropriate. The vacuum system being implemented in Gibeon and the Otji toilet pilots already discussed could be sources of valuable information to Karasburg about its sanitation options if such information were shared through a BMC.

A collaborative training program could improve the skills of local employees and enhance the capacity of the local authorities in the FRB. In order to have a more skilled and efficient workforce, training needs to be given to those working in the local authorities. The most pertinent subjects that a training program should address include accounting, record keeping, computer training, project management and water infrastructure maintenance. If the urban areas work together, a joint training program could be implemented at a lower cost to each community. With a larger group of interested parties these programs could take place more frequently and attract quality educators to teach these subjects. Routine training

workshops would help to alleviate the problem of unskilled workers. Collaborative training workshops will both enhance the productivity of the local authorities and instill in authority employees an understanding of how their day-to-day work fits in with the larger picture of the FRB.

5.5 RESOURCE MANAGEMENT

Karasburg and Keetmanshoop, like many other urban areas, have large, waterborne sanitation systems, but **alternatives to conventional waterborne systems could both save water and generate new economic value.** DEWATS, for example, could be used to treat water at minimal cost and produce water suitable for gardening or other applications involving unpurified water. DEWATS can also be used in conjunction with a biogas digester to produce methane gas and fertilizer. These products could be used directly by residents or sold, providing an immediate economic boost to the area. If dry sanitation systems were used, water usage would be reduced dramatically, freeing up resources for other applications, and material could still be produced for soil enrichment or energy production. In Noordoewer, the settlement office is currently lacking a suitable place to dispose of sewage extracted from septic tanks, but the sewage treatment methods such as a biogas system discussed in this report, could turn this problem into an opportunity to generate energy, fertilizer, and income.

Alternative sanitation methods could also increase sanitation coverage in the FRB. In informal areas that are too irregularly laid out for conventional sewerage to be installed, vacuum sewerage might be feasible, and wet or dry decentralized solutions certainly are. Additionally, in places such as Noordoewer where groundwater contamination is a concern, or in places where the ground is too rocky to install sewerage or pit toilets, toilets like the Enviroloo, JoJo, or Otji could be used, as they can be housed entirely above ground when necessary.

Local authorities and any future BMC should work with the Habitat Research and Development Centre in Windhoek to determine how such methods could be implemented successfully and with maximal benefit.

Using brackish groundwater, gray water, or other unpurified sources for non-consumptive purposes is an effective method of saving money and potable water. Using unpurified sources of water can conserve potable water sources as well as reduce costs residents must pay for water use. This can be an effective method of recovering costs, as

users will be able to afford to pay for water for both consumption and other domestic uses. When used, however, it should be noted that efforts should be made to ensure that community members are not drinking water from these sources.

Community members must be actively involved in any projects being implemented in urban areas. As was evident in the case of Keetmanshoop, where local residents were involved in every stage of the project to upgrade the informal settlement of Illeni, it is beneficial in many respects to involve community members in projects. When involved in planning and construction, participating community members gain skills that will be available for future projects. Involvement in such projects also enhances their ability to find employment opportunities and support themselves when the project reaches its conclusion. Another benefit to this approach is that utilizing community members as workers can significantly reduce the costs associated with such projects. Communities acquire a sense of ownership over the infrastructure that they help to plan and build, which inspires them to use the infrastructure properly and to report problems quickly when they arise. Finally, when community members are involved in such projects, which are intended to benefit the residents themselves, attitude changes towards local authorities may begin to take place. As noted in the Keetmanshoop project, at its conclusion community members began to realize that the municipality had their problems at heart.

5.6 POLITICAL MANAGEMENT

With the 2004 Water Resource Management Act, the Namibian government has committed itself to basin management as a countrywide strategy. Yet, water management decisions are still being made along the boundaries of Namibia's political regions. If basin management is to be truly effective, **water managers at all levels should treat basins as whole and distinct policy regions.** In the case of the FRB, this will require cooperation between regional councils of the Hardap and Karas regions, and recognition among policy-makers and other stakeholders of the importance of management on a basin level. Dividing the basin into two management sub-committees may be appropriate, as the basin's large area makes communication and meetings a difficult task for some important stakeholders. However, such a division should be made irrespective of the Hardap-Karas border. Rather, the division should be designed to enhance the logistics of basin management for stakeholders, and to preserve a broad representation of different kinds of stakeholders in each sub-committee.

In conclusion, a basin management committee composed of stakeholders from regional and local government, NamWater, and community members is potentially highly beneficial for the Fish River Basin. The largest obstacles to the formation of a committee are lack of communication between stakeholders, a lack of education about sustainability, and the fact that local authorities do not feel empowered to make decisions or implement solutions to problems in their urban areas. These recommendations are the starting point for methods by which each urban area in the Fish River Basin can function efficiently while doing their part to manage water resources in the basin. If these recommendations are accepted, a strong, capable basin management committee made up of informed and educated stakeholders will be successful and able to make significant contributions to the Fish River Basin.

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APPENDICES

APPENDIX A. DESERT RESEARCH FOUNDATION OF NAMIBIA

The Desert Research Foundation of Namibia (DRFN) is an organization whose goal is to promote sustainable development in Namibia (Klintenberg, 2007). Their objectives towards this goal are primarily informational, as described in the organization's mission statement:

> The DRFN empowers decision-makers at all levels through, capacity building, facilitation, knowledge generation and sharing in order to promote sustainable development (DRFN, 2007a, Water Desk).

The DRFN, based in Windhoek, has evolved over the years into what it is today. The DRFN was established in 1990 after Namibia gained independence (Klintenberg, 2007). The Desert Ecological Research Unit (DERU), established in October 1963 in Gobabeb, studied "ecological functioning of the desert" (DRFN, 2007, profile). By the time the DRFN emerged from the DERU, they had gained enough scientific information for the DRFN to have a good basis for a great start.

The many projects undertaken by the DRFN are organized under three main "desks": the land desk, energy desk, and water desk. Each desk is headed by Claus Hager, Robert Shultz, and Vivian Kinyanga respectively (von Oertzen& Erkana, 2007). Each of these desks oversees a number of projects and are all under the direction of Detlof von Oertzen. Additionally, one more desk was added to the DRFN in 2006, which manages publicity, marketing and publications. This desk is managed by John Pallett. The DRFN has a significant presence at Namibia's Gobabeb Training and Research Centre, a joint venture between the DRFN and the Namibian Ministry of Environment and Tourism. Finally, the DRFN offers commercial consulting services as the Environmental Evaluation Associates of Namibia. It is from this latter component that the organization as a whole receives most of its funding (Klintenberg, 2007).

The DRFN offers expertise and training in many areas related to sustainable development including resource monitoring, community organization, and the application of science and technology to sustainable development. The agency is overseen by a Board of Trustees(von Oertzen & Erkana, 2007). With 35 permanent employees and several volunteers, interns and students, the DRFN also acts as an agency to bring money and resources from other organizations to on-the-ground applications in Namibia (Klintenberg, 2007). At any one time, the DRFN has been known to work on more than fifty projects. The DRFN also acts as a knowledge generator by undertaking research projects like our own. For

instance, the Kuiseb River Basin project was the DRFN's first successfully implemented basin management system. WPI students played a part in this project conducting preliminary research.

Because the DRFN works to "empower decision makers", it is a natural collaborator with other organizations, institutions, and governments working on the problem of water management. The Fish River Basin project is part of the larger Ephemeral River Basins project, which is a collaboration between the DRFN and the many partners in the Southern African ephemeral river basins, including central and local governments, water suppliers, and end users at the community level (Klintenberg, 2007). This project is funded by the Norwegian Department of Foreign Affairs. Some other organizations that the DRFN has worked with or received funding from are:

- Namibian Ministry of Environment and Tourism
- Namibia's Economic Policy Research Unit
- Polytechnic of Namibia
- The nation of Spain
- United Nations
- Namibia Nature Foundation
- Namibia NGO forum
- The European Union

Water management is recognized by the DRFN as a key component to sustainable development in Namibia, hence the devotion of an entire branch of the organization to this area (Manning & Seely, 2005). The DRFN's further recognition that basins are "the appropriate units for operational management of water" guides its effort as part of the larger Ephemeral River Basins project to create a basin-wide water management system in Namibia's Fish River Basin (Klintenberg, 2007). Our evaluation of the Fish River Basin contributes directly to the effort of the DRFN in managing water resources within Namibia.

Informant: Martin Harris

Organization: NamWater
Topic: Water sources in the Fish River Basin, quantity of bulk water supplied to the basin

General Questions
1. What is your role at NamWater ?

NamWater Overview:
1. What are the roles and responsibilities of NamWater?
2. How is NamWater organized?
    a. Hierarchy
    b. Centralization/Decentralization
3. How do regional offices communicate?
    a. Do they communicate with each other or only with the central office?
4. Is NamWater financially independent or are you supported by other agencies?
    a. Customers, Government or Private?
    b. If Multiple sources, who provides what amount?
5. How many people does NamWater employ in the FRB region?
    a. In comparison to Namibia what percentage is this?
    b. Are local people employed in the regional offices?
    c. What kind of training do employees receive?
        i. Proportion in each job (technical vs. administrative)?
    d. How many offices do you have in the FRB?
    e. Where are they?

Cost Recovery:
1. What tariff system is used?
    a. Flat rate/Block system
2. Who sets the prices for water and how are they determined?
3. What is the price of water?
    a. Are there changes regionally?
4. How do you receive payment for water bills?
    a. At regional offices or directly to HQ?
5. Are there non-payment issues?
    a. Which specific areas of the FRB?
    b. What are the actual numbers for outstanding debt?
6. Are there any cost recovery systems planned?

Supply/Sources
1. Where are the sources of water for the FRB?
    a. Is sustainability being monitored? How?
    b. Do you foresee problems?
2. How sensitive is your supply system to drought and surplus?
3. How is the water delivered to the user?
    a. Trucks/Pipelines
    b. Average distance?
4. What is the volume of water that is unaccounted for?
    a. Where?
    b. Are there programs to combat water loss?

Fish River Basin

1. How much water is supplied to the FRB?
2. Do you distribute to private customers (ex. Mines) that then distribute to the areas around them?
3. What regions consume the most water?
4. What are the major applications of water?
    a. Which applications require the most water?

Sanitation and Quality of Water:

1. Is the quality of the water maintained in the process of delivering it?
2. Are there issues with the quality of the water at the source?
    a. Desalination
3. At what points do you test the water quality?
4. What standards do you use and who sets them?
    a. Do they vary for different areas
5. Do you work in conjunction with sanitation providers?

Demand Management:

1. Is demand management a concern?
2. Are there programs in place to deal with it?
3. Do you ask for feedback from your customers on the service you provide?
    a. If so, what are the comments you recieve?

Closing:

1. How can the system be improved?
    a. Specific Initiatives
2. Are there specific regions or issues that need more attention?
3. What area has the most potential for improvement?
4. What are your hopes and expectations for a basin management system in the FRB?
    a. What information would you like access to that we may be able to find out?
    b. We will be talking to other water experts.
5. Can you suggest any other people that would be beneficial to talk to?

Informant: Piet Heyns
Organization: DRFN Associate
Topics: Piet Heyns has a good overall view of the water sector, but especially on water supply- what water sources are used to supply who and how that is done, the water infrastructure such as dams, groundwater sources, etc. in the FRB as well as the Orange River.

General Questions

1. Can you tell us about your experience with water systems and IWRM strategies especially in relation to the FRB?

Water Supply to Urban Settlements:

1. Can you explain the water infrastructure system of urban settlements in the FRB?
    a. How is water stored?
    b. How is water delivered to residences, industry, and schools?
    c. Who is responsible for delivery of water?
2. Is water tested or treated after it is received from the bulk water supplier?
3. How are decisions made about how much water is allocated to each customer?
4. Are the dams in the region promoting sustainability?
5. Are there future dam projects in the works?
    a. Do you think they will have a positive effect or be sustainable?
6. Is the supply adequate for the population?

IWRM Strategies:

1. What Integrated Water Resource Management Strategies are already being used in the FRB?
2. Are the laws and regulations that are in place helping to promote IWRM?
    a. What are these laws?
    b. Could these laws be improved or better enforced? If so, how?
3. What types of communication and interaction occur between settlements or districts?

Water Infrastructure and Maintenance:

1. Who is in charge of maintaining the water infrastructure system?
2. How often is routine maintenance of the water system performed?
3. What kinds of problems occur?
4. What types of repairs are made?
5. Is a substantial volume of water unaccounted for?
    a. Are there programs to combat water loss?

Closing:

1. What information do you think will be important to find out about these urban settlements in regards to water infrastructure?
2. Can you suggest any people that would be valuable to speak with?

Informant: Dr. Andreas Wienecke
Organization: HRDC
Topics: Sanitation supply, infrastructure and maintenance to urban settlements
Questions:

Opening Questions

1. What is your role at the Habitat Research and Development Center?
2. Who is responsible for overseeing sanitation in the urban settlements in the FRB?
3. What specific strategies are used to manage sanitation?
4. How does the structure of the sanitation system influence water supply in the basin?
    a. How is it different regionally?
    b. What treatment processes for water are used before it is discharged?
    c. How is water from washing or "gray water" disposed of?
5. What are the major contaminants in the wastewater (organics, bacteria, etc.)?
    a. Where do they come from (e.g. industrial, agricultural, etc.)?
6. Are there communal/public toilets or bathhouses?
    a. How are they maintained?
    b. Is anyone in the local community trained to maintain them?
        i. Are they paid? By whom?
    c. Who is responsible for maintaining them? How is it determined?
7. How is sanitation paid for in the FRB?
8. Is the current sanitation system adequate?
9. What are the constraints on improving the sanitation system?
    a. Cost
    b. Technical Aspects
    c. Personnel
10. What concerns are there with the current system?
11. Are there sanitation education programs in communities?
    a. How are the programs established?
12. Are there any other projects currently being worked on in the FRB?
13. Are flush toilets or dry toilets commonly used?
    a. Which areas are they more prevalent?
    b. Which are preferred?
    c. Are there any other issues (besides cost) that influence the decision to stay with dry toilets vs switching to flush toilets?

Closing:

1. What information do you think will be important to find out about these urban settlements in regards to sanitation infrastructure?
2. Can you suggest any people that would be valuable to speak with?

Informant: Erna Awaseb
Organization: Ministry of Health and Social Services (MHSS)
Topic: Sanitation, Quality of Water, other Health Related Issues

General Questions

1. How much time do you have to spend with us today?
2. Do you know what areas the Fish River Basin covers?
    a. If not, give her a map of the region
3. Could you explain to us what the Ministry's role is in Namibia?
4. Could you explain to us what your role is at the MHSS?
    a. What services are you responsible for – anything in the FRB?
5. Is the Ministry making a larger effort this year, since it is the year of Sanitation?
6. Are there any projects dealing with sanitation that the Ministry is working on, especially in the South?
    a. Where? Involving what?
7. What is the Ministry's relationship with NamWater?
    a. Do you collaborate on sanitation issues?

Sanitation

1. What kinds of different sanitation systems are used in the FRB (septic systems, French drains, wet/dry sanitation, etc.)?
    a. What types do people in the FRB prefer?
2. Do people feel as though sanitation is important or not?
3. Are there communal/public toilets in the FRB?
    a. How are they maintained?
    b. Is anyone in the local community trained to maintain them?
        i. Are they paid? By whom?
        ii. Who is responsible for maintaining them?
4. Are problems with flooding from dams in the FRB a health concern?
    a. Mention we know flooding occurred from Hardap Dam 2000 and 2006
5. How is the MHSS involved with sanitation in the FRB?
    a. Who do you work with?
    b. What settlements?
6. Do people pay for sanitation? Who exactly?
    a. How do they pay?
    b. When do you step in?
    c. What do you do if they cannot pay?
7. What sanitation standards are used? Does the Ministry set these standards?
8. Is the current sanitation system adequate in the Fish River Basin?
    a. Do you have regional offices, anyone in the FRB?
    b. Are some regions in the FRB doing worse than others?
    c. What is constraining making improvements?
9. Are there sanitation/water quality issues with the Orange River?
10. Do you provide educational training for the communities you assist?
    a. How? When?
    b. If not, does anyone?
    c. Who pays for the training?
        i. Grants? Participants? Suppliers? Etc.
11. Do you support communities who cannot support themselves?

    a. How? Through subsidies?
    b. How do you determine who “can’t” pay and who “won’t” pay?
12. What treatment processes for water are there before it is discharged?

Quality of Water:

1. What methods do you use for testing the quality of the water?
2. What are the major contaminants in the wastewater (organics, bacteria, etc.)?
    a. Where do they come from (e.g. industrial, agricultural, etc.)?
    b. Is water quality a concern in the FRB?
3. After hearing about the Cholera outbreaks in the North, is there a concern with the quality of the water supply?
    a. Is anything being done to improve water quality there?

Closing Questions:

1. Are there any other institutions/areas of government which deal specifically with sanitation and water quality?
2. Is there anyone specifically in the South whom you feel it would be beneficial for us to speak with?
3. Is there anyone else you believe it would be beneficial for us to speak with?

Informant: Ben van der Merwe
Organization: ENVES
Topics: Water tariff systems & cost recovery; water demand & IWRM strategies, etc
Questions:

1. What are the most common water tariff systems in Namibia?
    a. Do they vary within Namibia?
    b. What factors determine the kind of tariff system used?
    c. What are the pros/cons of each system?
2. Are people at a subsistence level expected to pay for their water?
    a. At what rate?
    b. How do they pay?
3. What happens if people cannot pay for water?
4. What kinds of strategies are in place to deal with this debt?
    a. Subsidies?
    b. Loans?
    c. Improved tariff collection?
5. How much is water subsidized in Namibia (e.g. in dollars or liters)?
    a. Are subsidies targeted in any way?
    b. Are subsidies politically determined?
6. Does NamWater ever shut off water to an area because a community has acquired too much debt?
    a. How often does this happen?
7. Do you think the current system of paying for water is equitable?
8. Are there local water committees?
    a. What is their role?
    b. How are committees formed?
    c. Do local committees control water prices?
9. How do people feel about paying for water services?
    a. What are the reasons for these feelings?
    b. Do these attitudes correlate with other factors such as age, location, ethnicity?

Demand Management

1. How is water demand measured or estimated?
    a. Are existing methods reliable?
2. Who works to manage water demand?
3. What is the limiting factor to water use?
    a. Cost?
    b. Supply?
    c. Attitudes?
    d. Environmental/social concerns
4. What types of conservation strategies are being utilized in urban settlements?
5. What strategies *should* be implemented?
6. How can we evaluate demand management strategies while visiting the Fish River Basin?
    a. Can you suggest anyone we should speak with?

Informant: HanjorgDrews
Organization: NamWater
Topic: Quantitative data

Opening Questions

2. We know you are the bulk water supplier, but what is NamWater's role in the regional offices?
    a. What happens day to day?
    b. What kind of people do you employ?
    c. What responsibilities do they have?
3. What water sources are available in the FRB?
    a. What percentage do boreholes supply? Standing water? Dams?
4. How much water do people use daily?
    a. Residentially
        i. How much water per household?
    b. Commercially
    c. Irrigation
    d. In areas owned by the government
5. How much water is supplied to the Fish River basin?
    a. Which companies do you sell the bulk water to?
    b. Is any supplied from sources outside the country?
    c. Or from companies other than NamWater
    d. Is maintained effective? (Are there minimal repairs needed, or much more?)
        i. Above ground? Below ground?
        ii. Is it cost beneficial to deliver water to remote areas through piping?
6. Is the rate in the FRB the same for all customers?
    a. If not, what are the different rates?
    b. Why do they vary?
7. How do you receive payment for water bills?
    a. Do regional NamWater offices oversee cost recovery/ payments or do payments go straight to you?
    b. Is getting payment a problem?
    c. Are you aware if any subsidies are used?
8. Do you receive enough payment for NamWater to run effectively?
9. Do you ask for feedback from your customers on the service you provide?
    a. If so, what are the comments you get?

Closing:

1. What information do you think will be important to find out about these urban settlements in regards to sanitation infrastructure?
2. Can you suggest any people in the FRB that would be valuable to speak with?

Interview with WaterMasters

General Questions:

1. What does WaterMasters do?
2. Do you manufacture other items besides pre-paid meters?
3. Can you tell us about this history of WaterMasters?
4. What are the responsibilities of the Windhoek branch?
5. Do you have other branches or trained personnel specifically in the FRB?

Specific Product Information

1. Do you design the meters or just manufacture them?
2. How do they work?
3. Are there multiple types of meters? How do they vary?
4. Did WaterMasters develop the software for the prepaid meters?
5. What type of testing do you perform before releasing the meters and software?
6. How often do you update the software or meter specifications?
    a. Do you send out software updates?

Cost

1. How much do they cost to manufacture?
2. How much do you sell the meters for?
3. Do you have a financing program?
4. Is it on an individual basis?
5. Do you have outstanding accounts with local authorities in the FRB?
    a. What steps do you take with these local authorities?

Customer Care

1. With initial installation what types of support do you provide?
    a. Who installs the meters?
    b. Is training given to your customers? What types?
    c. Are their warrantees or guarantees that you provide with the meters?
2. What type of follow up care do you offer?
3. What are the major performance issues with the meters or software?
    a. How do you respond to these issues?
4. Do you have a maintenance team?
    a. How often do you go on site?
    b. What type of issues do they deal with?
    c. What type of training do they receive and where?
5. Do you provide replacement parts to customers?
    a. Where do these parts come from?
    b. How long does it take?
    c. Is it needed often?
    d. Who installs these parts?
    e. Are you the only provider of parts?
6. How do you communicate with the customers?
    a. Are customers operating the prepay meters correctly?

Market

1. What are WaterMasters strengths as a company?
2. Are you in demand?
3. Are you able to keep up with this demand?
4. Do you have any upcoming installation projects? Where?
5. Which companies are WaterMasters major competition in the prepay market?
6. Who are your customers?

7. How do your customers find out about WaterMasters?
8. How do you market to local authorities?

Closing

1. Can you provide us with information about the prepaid meters?

Interview Questions for Local Officials during Field Expedition

Opening Questions

1. What is your personal position and role within the local authority?
2. What is the role of the authority in regards to water and sanitation?

Water Infrastructure

1. How many maintenance people do you employ?
2. What kinds of training do personnel receive?
3. Do you have enough trained people to effectively operate?
4. How often is maintenance performed?
    a. What are your major maintenance issues?
    b. How much water loss do you have?
5. How is water delivered to the user?
6. How many standpipes do you have?
        i. Where are they located
        ii. How long is the wait for water?
        iii. What is the average distance from homes?
7. What types of meters do you have?
        i. How many are there? Where are they located?
        ii. What issues do you have with your meters?
        iii. Who is your prepaid meter provider?
8. Are people getting water from non-potable sources?
9. Are there any ongoing or future projects the local authority is looking to do?

Sanitation Infrastructure

1. Who is in charge of sanitation?
2. What types of sanitation facilities are there in your community?
    a. Where are they located?
    b. How many are there?
    c. Are there communal facilities?
        i. How many households are using one facility?
3. Are there any problems with these facilities?
4. What types of facilities are preferred?
    a. By the community? By service providers?
5. Who is in charge of maintenance?
6. Are there any ongoing or future projects the local authority is looking to do?

Tariffs and Cost Recovery

1. How does the payment structure work?
2. What is the price of water to the user?
    a. Is it different for businesses and residences?
3. Is there a basic charge?
    a. How much is it?
    b. Is it different for businesses and residences?
4. What is the charge for sanitation services?
5. What is the price of bulk water?
6. Do you have trouble recovering your costs?
7. Are people paying their water bills?
    a. Do you have payment programs for those who are unable to pay for water?
    b. What are the reasons for non-payment?
8. When water users have a problem, what measures can they take?
9. How much money is owed to the Local Authorities for water?
    a. What is being done to combat this debt?
10. How much money is owed to NamWater by the local authority?
11. Has NamWater ever cutoff or threatened to cutoff services for non-payment?
12. Do you receive financial assistance from the regional council or other organizations?

Educational Programs

1. Is there anything being done to try to conserve water?
2. What programs are in place in regards to water and sanitation education?
    a. Who funds these programs?
    b. Is Ministry of HSS providing education on hygiene?
3. Is there recycling or reclaiming of water?

Communication

1. What is your relationship like with NamWater?
2. Are you able to give NamWater feedback, and is your feedback taken into account?
3. Does NamWater assist you in addressing your own infrastructure or payment issues?
4. Do regular meetings take place between the community and the local authority?
    a. What are the issues that come up at these meetings

Water Quality

1. Are there any health related issues associated with the water quality?
2. Does the local authority ever perform water testing?
3. Where is water testing performed?
    a. Upon delivery by NamWater? Somewhere else in your infrastructure?
4. How often is testing performed?

Decentralization

1. Is decentralization of the water system appropriate for the region?
    a. Is a basin committee, comprised of different representatives from different sectors appropriate? Or should one ministry, group of officials, etc. assume responsibility?
2. Who should take a leading role in a basin committee?
3. How to you see a basin management committee beneficial to your community?

Interview Questions for Community Development Committees during Field Expedition

Opening Questions

1. What is your position within the community development committee?
2. Is the committee active?
3. What is the community development committee's role in regard to water and sanitation?

Water Infrastructure

1. What are the major problems with the water infrastructure?
2. How is water delivered to the user?
    a. If standpipes
        i. Where are they located
        ii. How long is the wait for water?
        iii. What is the average distance from homes?
        iv. What are the issues with standpipes?
3. Does everyone have access to water?
4. Are people getting water from non-potable sources?
5. What types of meters are used?
    a. Are there problems with the meters?
        i. What are those problems?
        ii. How quickly are they dealt with?
6. Do you know of any ongoing or future projects the local authority or community development committee is looking to do?

Sanitation Infrastructure

1. Who is in charge of sanitation services?
2. What types of sanitation facilities are there in your community?
    a. Where are they located?
    b. How many are there?
    c. Are there communal facilities?
        i. How many households are using one facility?
3. Are there any problems with these facilities?
    a. What are they?
4. What types of facilities are preferred?
    a. By the community? By service providers?
5. Who is in charge of maintenance?
    a. Is it being performed often enough?
6. Do you know of any ongoing or future projects the local authority or community development committee is looking to do?

Tariffs and Cost Recovery

1. How does the payment structure work?
2. What is the cost of water to the user?
3. Is water affordable?
4. Are people able to pay?
    a. What are the reasons for nonpayment?
5. When a person can not pay what happens?
    a. If water is turned off what water sources do they use?
6. When water users have a problem, what measures can they take?

Educational Programs

1. Is there anything being done to try to conserve water?
2. What programs are in place in regards to water and sanitation education?
    a. Who funds these programs?
    b. Is Ministry of HSS providing education on hygiene?

Water Quality

1. Are there any health related issues associated with the water quality?
2. Have there been in the past?

NamWater, Local Authorities, and Regional Authorities

1. Do you have regular meetings with the community?
    a. How often?
    b. What type of forum is used?
    c. What are the major issues that are brought up?
2. What is your relationship with the Local Authorities?
3. What is your relationship with the Regional Council?

Decentralization

1. Would you like more input on how water supply is managed?
2. Is decentralization of the water system an appropriate management method for the region?
    a. Is a basin committee, compiled of different representatives from different sectors, appropriate? Or should one ministry, group of officials, etc assume responsibility?
    b. Who should take a role in a Basin Committee?
3. How to you see a basin management committee beneficial to your community?

Interview Questions for Regional Officials during Field Expedition

Introduction

1. What is the regional council's role in regards to water and sanitation?
2. What is your role personal in the regional council?

Water Infrastructure

1. What types of support do you offer settlements offices?
2. What kinds of training do personnel in the settlement offices receive?
    a. Are there regional training programs as well as local ones?
3. Do you assist with maintenance?
4. When settlement offices have a maintenance problem, what steps do they take to resolve it?
5. How is water delivered to the user?
6. Which settlements use standpipes?
    a. How long is the wait for water?
    b. What is the average distance from homes?
    c. Are there issues with this distribution system?
7. What types of meters are used in the settlements?
    a. How many are there? Where are they located?
    b. What issues are there with the meters?
    c. Who is the prepaid meter provider?
8. Are people getting water from non-potable sources?
9. Are there any ongoing or future projects the regional council is looking to do?

Sanitation Infrastructure

1. Who is in charge of sanitation operations?
    a. Do you offer them support financially or with personnel?
2. What types of sanitation facilities are used in the settlements??
    a. Where in the settlements are they used?
    b. Are they communal
    c. Are there any problems with these facilities?
    d. What are the local perceptions? Are they liked or disliked?
    e. What types of facilities are preferred by you or by communities?
3. What types of wastewater treatment methods are utilized in the settlements?
4. What settlements need the most assistance in regards to sanitation?

Tariffs and Cost Recovery

1. How does the payment structure work?
2. Does the payment from the settlement offices to NamWater go through you?
3. How much do you pay for bulk water supply?

4. What are the settlements charging for water?
5. Do you have debt to NamWater?
6. Are there settlements that are not recovering costs with regard to water?
7. What happens to settlements that are unable to recover the cost of water?
8. Has water ever been turned off to settlements?
    a. Which ones?
    b. What steps are taken to have the water turned back on?
9. Is water affordable for users?

NamWater

1. What type of communication exists between the regional authority and NamWater?
2. How do you think NamWater could improve as a bulk water supplier?

Local Authorities

1. What lines of communication exist between the settlement offices and the regional authorities?
2. Do the settlement offices speak with NamWater directly ever?
    a. For what purpose?

Educational Programs

1. Do people see the need to conserve water?
2. Are there any programs in place to try to conserve water?
    a. Individually, Locally, Regionally
3. What programs are in place in regards to water and sanitation education?
    a. Who funds these programs?
    b. Is Ministry of HSS providing education on hygiene?

Water Quality

1. What standards do you follow for water quality?
2. Where is water testing performed?
    a. By whom?
3. How often is it performed?
4. Are there any health related issues associated with the water quality?
5. Which settlements have the poorest water quality?

Decentralization

1. Is decentralization of the water system an appropriate management method for the region?

a. Is a basin committee, compiled of different representatives from different sectors, appropriate? Or should one ministry, group of officials, etc assume responsibility?
b. Would you like more input on how water supply is managed?
c. Who should take a role in a Basin Committee?

Questions for Regional NamWater Offices

Introduction

1. What is the role of the regional office?
2. What is your role/title at NamWater?

Water Sources

1. What water supplies do you use to supply the urban areas?

Infrastructure

10. How often do you perform maintenance on your systems?
11. How much water loss do you have?
    a. What are the reasons for water loss?
12. How is water delivered to your customers?
13. What are the most costly areas to reach?
14. Do you lack trained personnel?
    a. In what sectors of your company (maintenance, finance, managerial, etc)
15. Are currently working on or planning any new projects?

Tariffs & Cost Recovery

1. Do regional NamWater offices oversee cost recovery/ payments or do payments go straight to the main office?
    a. Are there issues with payment?
    b. Are you aware if any subsidies are used?
        i. Are the suppliers subsidized for the system as a whole or are individuals subsidized?
2. How are costs determined?
    a. Who determines them?
3. What is the amount of money owed to NamWater for each of the urban settlements?
    a. Why are some areas unable to pay?
4. What happens when communities cannot pay?
    a. Do you ever shut off water to areas? Which ones?
    b. What is the protocol to get the water turned back on?
    c. Do suppliers/ users follow protocol to get the water turned back on?
5. Can you tell us the prices of water for the customers in the FRB?

Water Quality

1. In what areas are there issues with water quality?
2. What are sources of contamination?
3. What standards do you follow?
    a. WHO? Other?
4. Where and how often do you test the water?

Communication

1. Do you have communication with your customers?
    a. What kinds of feedback do they give you?
2. Is there communication between regional NamWater offices?
3. What decision making power does the regional NamWater office have?

Decentralization

1. Is decentralization of the water system an appropriate management method for the region?
    a. Is a basin committee, compiled of different representatives from different sectors, appropriate? Or should one ministry, group of officials, etc assume responsibility?
    b. Who should take a leading role in a Basin Committee?

Village of Bethanie

Water:	
Distribution Methods:	In House Taps Standpipes (10)
Types of Meters:	Conventional (195) Prepay (384)
Water Source:	Boreholes
Tariffs (per cubic meter):	
Water tariff - residents conventional	N$7.68
Water tariff- residents prepay	N$8.00
Water tariff- business	N$7.90
Basic charge - residents	N$45.00
Basic charge - business	N$90.00
Bulk Water Supply	N$5.85
Debt to NamWater	N$380,399.23

Sanitation:	
Methods:	Septic Tanks (1)
	Bucket System (300)
Monthly Tariffs:	
Residential	N$20.00
Business	N$20.00

Facts:
Population: 1,017
Region: Karas
Number of Schools: 4
Medical Facilities: 1 Health Center

The Village of Bethanie is implementing a construction plan over the next three years to move the entire community to flush toilets. The project will cost N$6 million. In addition to this project the Village Council is looking to replace all the conventional meters with a prepay system. For maintenance, the Council employs two people. They have never been formally trained but have over 20 years of experience. The water quality in Bethanie is very poor and classified as class C because of the fluoride content. In 2007 NamWater wrote off the Village's debt because of the water quality. The Village has bought two boreholes to offset the high cost of water, but is waiting for a reply from the Ministry to be permitted to use them. The water is delivered through communal standpipes in the informal settlements and through household taps in the formal areas. Approximately ten households share a standpipe.

Community Development Committee Member, Anna Fredrick

Members of Bethanie Village Council

Village of Gibeon

Facts:
Population: 2,537
Region: Hardap
Number of Schools: 6
Medical Facilities: 1 Clinic

WPI student and Councilor Samuel Karigub of the Village Council

Water:	
Distribution Methods:	In House Taps Standpipes
Types of Meters:	Conventional Prepay
Water Source:	Boreholes
Tariffs (per cubic meter):	
Water tariff - residents conventional	N$6.03
Water tariff- residents prepay	N$7.07
Basic charge - residents	N$35.87
Basic charge - business	N$107.59
Bulk Water Supply	N$5.40
Debt to NamWater	~N$55,000

Sanitation:	
Methods:	Vacuum Bucket System
Monthly Tariffs:	
Vacuum Residential	residential basic N$13.04 + N$7.82/toilet
Vacuum Business	business basic N$19.56 + N$15.64/toilet
Bucket System	N$22.83/month

Gibeon has the only vacuum system in the FRB. It is still not clear what the cost will be to consumers to hook up to the recent installation. In their infrastructure they have estimated water loss to be around 49% . The planning of the town was done after homes were already built, and houses were built onto of pipelines that will eventually need to be replaced. The water loss has led to debt to NamWater, which the town has dealt with by using development funds. Up until last year the Village Council was selling water at a loss. In order to improve cost recovery they combine electricity with water services. Then when a water bill is not paid the electricity to the home is also cut. The Village Council has seen good results from this system.

Settlement of Grünau

Facts:
Population: 379
Region: Karas
Number of Schools: 1
Medical Facilities: none

Maintenance is performed by the Settlement Officer and his assistant. If the problem can not be resolved by them, then they contact the Regional Council. There are 4 standpipes in the settlement. They are equipped with prepay meters and are located in the informal area. There are no serious health related issues due to the water quality. The Settlement Officer does report that the water is brackish and leaves calcium deposits on dishes. One of the major problems in the area is unemployment. This is partially a result of water issues, because the price of water is preventing economic developments like gardening and poultry farming. Unemployment is making cost recovery difficult, do deal with this the Settlement Office often requires people to pay off some of their debt in order to recharge their prepay tokens.

Settlement Officer in Grünau holding a prepay water token

Water:	
Distribution Methods:	In House Taps Standpipes (4)
Types of Meters:	Conventional (24)
	Prepay (28)
Water Source:	Boreholes
Tariffs (per cubic meter):	
Water tariff - residents	N$9.50
Water tariff - business	N$9.50
Basic charge - residents	N$28.00
Basic charge - business	N$130.00

Sanitation:	
Methods:	Septic Flush (10)
	Communal Pit Latrines (20)

Daniel Bantam explaining some records to a WPI student

Panoramic view near the Settlement Office

Village of Kalkrand

Facts:
Population: 1,038
Region: Hardap
Number of Schools: 6
Medical Facilities: None

Sanitation:	
Methods:	Septic Flush (78)
	Bucket System (79)
Monthly Tariffs:	
Bucket System	N$5.00/bucket
Septic Flush	N$30.30

Kalkrand has a calculated 26.3% water loss in their distribution system. The Village Council has a difficult time getting people to come assist with training because there is no where in the Village for those people to stay. The conventional meters are located at schools and on government property. The Ministry paid Kalkrand's debt to NamWater on January 23rd 2008. The amount was $234,740.76. Since that time no further payments have been made to NamWater. At this time the Village is in debt to NamWater once again and they are threatening to cut off the water supply. If consumers do not pay for water the local authorities will only turn on the tap certain times of day. Currently there is an interim CEO hired at the local office. He has been hired for a period of three months. In the 3 weeks prior to our interview 3 new personnel have been hired. The previous CEO had also only served for 3 months. The Village used to get their water from boreholes and it was brackish. Now they get their water from the Fish River and the quality is much better.

Kalkrand Village Office

Water:	
Distribution Methods:	In House Taps Door Side Standpipes
Types of Meters:	Conventional (23) Prepay (14)
Water Source:	Boreholes
Tariffs (per cubic meter):	
Water tariff - residents	N$9.05
Water tariff - business	N$9.05
Basic charge - residents	N$25.00
Basic charge - business	N$75.00
Bulk Water Supply	N$6.80
Debt to NamWater:	N$163,649

Municipality of Karasburg

Facts:
Population: 3,966
Region: Karas
Number of Schools: 5
Medical Facilities: 1 Hospital, 1 Clinics

Sanitation:	
Methods:	Septic Flush (420)
	Conventional Waterborne (591)
Tariffs:	
Residential Septic	N$54.00 as needed

Treasurer, CEO and Mayor of Karasburg

Water:	
Distribution Methods:	Private Taps
Types of Meters:	Conventional (1078)
Water Sources:	Naute Dam, Boreholes
Tariffs (per cubic meter):	
Water tariff	N$10.10
Monthly basic charge	N$34.00
Bulk Water Supply	N$7.10
Debt to NamWater:	N$0.00

An interesting fact about Karasburg is that it has more advanced sanitation systems in their informal areas than in the formal. Conventional sewagerage is used in the informal areas while other areas are using septic systems. The municipality is looking to upgrade their septic systems to some other type of waterborne sewage in the future. They are also looking into purchasing prepay meters, right now they are only using conventional. They are concerned about the potential tariff rise to cover the cost of these meters. Each household, including those in the informal settlement have a private tap. The municipality employs five people who have on the job training. Water loss is at about 15% and as leaks are found in the old galvanized steel pipes they are replaced with PVC pipes.

Conventional sewage toilet in the informal settlement in Karasburg, project partially funded by the European Union

Municipality of Keetmanshoop

Facts:
Population: 14,824
Region: Karas
Number of Schools: 18
Medical Facilities: 1 Hospital, 2 Clinics

Sanitation:	
Methods:	Conventional Waterborne (3617)
Monthly Tariffs:	
Residential	N$36.75/toilet
Business	N$52.50/toilet

Chief Executive Officer of Keetmanshoop, Mr. Patrik Hamann

Private Standpipe at a Residence in the Informal Settlement

Water:	
Distribution Methods:	In House Taps Door Side Standpipes
Types of Meters:	Conventional (3617)
Water Source:	Boreholes
Tariffs (per cubic meter):	
Water tariff - residents	N$8.70
Water tarriff - business	N$8.70
Basic charge - residents	N$36.30
Basic charge - business	N$139.15
Bulk Water Supply	N$5.93
Debt to NamWater:	N$800,000

Keetmanshoop is a part 2 municipality which provides each household with their own conventional sewage system and water tap, even in the informal settlement. During the installation of these systems local people were hired. Although the project took slightly longer, the municipality now has a trained group of ten full time and fifteen part time personnel to perform maintenance on the system. The CEO estimates water loss at 11% within the infrastructure. In addition to receiving their bulk water supply from NamWater Keetmanshoop has four municipal boreholes, two of which are active. This water is used for non-potable purposes including watering parks, athletic fields, and filling the public swimming pool. There is no known community development committee in place.

Village of Maltahöhe

Facts:
Population: 1,663
Region: Hardap
Number of Schools: 2
Medical Facilities: 1 Clinic, 1 Health Center

Maltahöhe was the only urban area visited that was selling water to consumers for less than they were buying it for. The Village Council is planning on installing two Otji toilets in the informal settlements as a pilot project. They are also looking to move their oxidation ponds because as of now they are located in an area that would be good location for businesses. There are currently four people employed to work on maintenance issues. There are ten standpipes located in the informal area, but only two are working. That mean 270 households are sharing two taps so long wait times may be a problem.

Water:	
Distribution Methods:	In House Taps Standpipes
Types of Meters:	Conventional (146) Prepay (2)
Water Source:	Boreholes
Tariffs (per cubic meter):	
Water tariff - residents	N$5.51
Bulk Water Supply	N$5.93
Debt to NamWater	N$470,000

Sanitation:	
Methods:	Septic Flush

Municipality of Mariental

Facts:
Population: 9,172
Region: Hardap
Number of Schools: 8
Medical Facilities: 1 Hospital, 1 Clinics

Sanitation:	
Methods:	Conventional Waterborne

Mariental is a part 2 municipality. They have 14.5% water loss within their infrastructure. They use a block tariff system to charge businesses for water. They were the only urban area in the basin selling unpurified water. In the informal settlement there is no formal sanitation system. They are hoping to do a pilot project with the Otji toilet. As a municipality Mariental is not allowed to have VIPs. In the formal area where this is a conventional sewerage system, the pumps are at capacity and must be upgraded. Mariental is also working to upgrade their infrastructure. Currently 70% of the pipes are made of asbestos and since 2000 they have been working towards replacing those with PVC. To recover costs for water services they cross subsidize with other services such as electricity.

Irrigation scheme outside of Mariental

Hardap Dam

Water:	
Distribution Methods:	In House Taps Standpipes
Types of Meters:	Conventional (2300)
	Prepay (90)
Water Source:	Hardap Dam
Tariffs (per cubic meter):	
Water tariff - residents	N$7.12
Basic charge - residents	N$17.00
Unpurified Water	N$1.00
Bulk Water Supply	N$5.93
Debt to NamWater:	N$0.00

Village of Tses

Facts:
Population: 904
Region: Karas
Number of Schools: 0
Medical Facilities: 1 Clinic

Sanitation:	
Methods:	Conventional Waterborne (79)
	Bucket (42)
Monthly Tariffs:	
Residential	N$16.60
Bucket	N$5.00/bucket
Business	N$45.00

Water:	
Distribution	In House Taps Standpipes
Types of Meters:	Conventional (176)
	Prepay (12)
Water Source:	Boreholes
Tariffs (per cubic meter):	
Water tariff - residents	N$8.00
Basic charge - residents	N$26.00
Basic charge - business	N$90.00
Bulk Water Supply	N$6.95
Debt to NamWater:	N$615,962.93

CEO of Tses, Mr. Ivan P. Vries

Tses has over 40% water loss within its infrastructure. The Council is putting in a conventional sewage system in the informal area. Right now the communal bucket system is used with approximately 6 households per bucket toilet. There are currently 72 houses without meters who get charged a basic fee. The Village gets its water from 3 boreholes. Two are located near the Fish River and the other is located near the Tses River.

Settlement of Noordoewer

Facts:
Population: 1,085
Region: Karas
Number of Schools: 1
Medical Facilities: 1 Clinic

Sanitation:	
Methods:	Septic Flush (8-10)
	Pit Latrines
Monthly Tariffs:	
Septic	N$30.00

Settlement Development Committee Member, Nestor Twaitavela

Interview with Settlement Officer, Katrina Cloete

Water:	
Distribution Methods:	In House Taps Standpipes
Types of Meters:	Conventional (130) Prepay (90)
Water Source:	Orange River Borehole
Tariffs (per cubic meter):	
Water tariff - residents	N$9.50
Water tarriff - business	N$9.50
Basic charge - residents	N$28.00
Basic charge - business	N$130.00
Debt to NamWater:	N$0.00

Most people use self dug pit latrines. They must be careful with the pit latrines because of their close proximity to the Orange River. The Settlement lacks an appropriate dumping area for the waste taken out of septic systems. There are 5 standpipes to service the 63 households in the squatter camp. Water services are cut to those who do not pay after 2 months. When the services are cut people often go to the canal to collect water. This water is unpurified and people often get sick from drinking it. The settlement is trying to deter people from using this water by educating them, and also trying to get a stronger police presence in the area.

TABLE 13 WATER TARIFFS

Water Tariffs (N$)						
	Residential water tariff conventional per m^3	**Residential water tariff prepay per m^3**	**Business water tariff per m^3**	**Residential monthly basic charge for conventional meters**	**Business monthly basic charge for conventional meters**	**Tariff local authority pays NamWater per m^3**
Klein Aub Settlement	ND	ND	ND	ND	ND	ND
Noordoewer Settlement	9.50	9.50	9.50	28.00	130.00	ND
Grünau Settlement	9.50	9.50	9.50	28.00	130.00	ND
Bethanie Village	7.68	8.00	7.90	45.00	90.00	5.85
Gibeon Village	6.03	7.07	ND	35.87	107.59	5.40
Kalkrand Village	9.05	9.05	9.05	25.00	75.00	6.80
Maltahöhe Village	5.51	ND	ND	ND	ND	5.93
Tses Village	8.00	ND	ND	26.00	90.00	6.95
Karasburg Municipality	10.10	N/A	10.10	34.00	34.00	7.10
Keetmanshoop Municipality	8.70	N/A	8.70	36.30	139.15	5.93
Mariental Municipality	7.12	ND	ND	17.00	ND	5.93

Note: We did not observe any basic charges for prepay meters.

TABLE 14 OUTSTANDING DEBT OWED TO LOCAL AUTHORITY AND NAMWATER FOR WATER SERVICES

OUTSTANDING DEBT (N$)		
	Total outstanding debt that consumers owe Local Authorities	Total outstanding debt that Local Authorities owe NamWater
Klein Aub Settlement	ND	ND
Noordoewer Settlement	90,898.75	0.00
Grünau Settlement	278,763.31	0.00
Bethanie Village	62,596.43	380,399.23
Gibeon Village	ND	50,000 - 60,000
Kalkrand Village	1,261,761.00	163,649.00
Maltahöhe Village	0.00	470,000.00
Tses Village	ND	615,962.93
Karasburg Municipality	2,418,981.97*	0.00
Keetmanshoop Municipality	ND	800,000.00
Mariental Municipality	603,578.17	0.00

*Total arrears for all municipal services

TABLE 15 NUMBERS OF METERS IN URBAN AREAS

Numbers of Working Meters		
	Conventional Meters	**Prepay Meters**
Klein Aub Settlement	ND	ND
Noordoewer Settlement	130	90
Grünau Settlement	24	28
Bethanie Village	195	384
Gibeon Village	ND	ND
Kalkrand Village	23	14
Maltahöhe Village	8	146
Tses Village	176	12
Karasburg Municipality	1078	0
Keetmanshoop Municipality	3617	0
Mariental Municipality	2300	90

TABLE 16 SANITATION METHODS UTILIZED

Sanitation Methods						
	Wet Sanitation			Dry Sanitation		
	Conventional Sewerage	Septic Tanks	Vacuum Sewerage	Long Drop/ Pit Latrine	Bucket System	Bush
Klein Aub Settlement	ND	ND				ND
Noordoewer Settlement		10		ND		
Grünau Settlement		10		20		
Bethanie Village		1			300	
Gibeon Village			ND		ND	
Kalkrand Village		78			79	
Maltahöhe Village		ND				ND
Tses Village	79				42	
Karasburg Municipality	591	420				
Keetmanshoop Municipality	3617					
Mariental Municipality	ND					ND

TABLE 17: VOLUMES OF WATER SUPPLIED TO THE LOCAL AUTHORITIES BY NAMWATER

Volumes of Water supplied by NamWater to the Local Authorities per m^3	FEB' 07	MAR' 07	APR' 07	MAY' 07	JUN' 07	JUL' 07	AUG' 07	SEPT '07	OCT' 07	NOV' 07	DEC' 07	JAN' 08
Mariental Municipality	80875	77888	81710	64228	62900	62117	56216	60397	128612	70716	47148	47148
Keetmanshoop Municipality	143953	135078	131382	152830	104305	103390	104703	137615	128612	134032	133038	209743
Karasburg Municipality	31869	26828	25003	21240	18237	20334	20883	19687	21062	23892	16437	25466
Tses Village	6525	5899	6327	8339	7795	4062	7501	6157	5788	5373	5774	7616
Maltahöhe Village	9485	7740	8830	6960	6740	6615	6825	7050	7740	9140	7355	13165
Kalkrand Village	3871	3381	3817	2603	3096	2289	2388	2388	2658	3669	2127	4120
Gibeon Village	12535	13145	15280	10760	11130	10595	9050	10040	9480	10130	7065	17570
Bethanie Village	6525	5899	6327	8339	7795	4062	7501	6157	5788	5373	5774	7616
Grünau Settlement	920	870	898	878	883	869	879	865	823	892	566	1094
Noordoewer Settlement	3004	2621	2168	1961	1961	2029	2144	2044	2045	2474	1612	2744
Klein Aub Settlement	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

APPENDIX F: TRADITIONAL LAND USE

Communal land is a traditional method of land ownership in Namibia. Communal land tenure is found in areas of the world where land is used as an economic system. Instead of paper money, the community relies on hunting, fishing, livestock, etc., to survive (Hangula, 2000). The land is communal and everyone in the community shares ownership. This was the most common form of land tenure in Namibia until the Europeans arrived in southern Africa in the late 1880s (Hangula, 2000). They brought a new land ownership concept called "freehold" land tenure. With freehold tenure, owners purchase the land, pay taxes, and observe land use controls. With this type of individual ownership, owners are accountable for the land and taxes paid on it, but do not have to share the land with other community members. Namibians were vulnerable to this new concept because land ownership by a single person had never been considered. Because they had no formal ownership, the Europeans felt free to take the land from the Namibians and claim it as their own.

The Namibian farming methods can be broken up into five categories: small-scale cereals and livestock, cattle ranching, small stock raising, intensive agriculture and natural resource production (Mendelsohn, 2006). The main form of land use in the Fish River Basin is small stock husbandry with a few sections along the Orange River with intensive,irrigated agriculture. Small stock farming, generally sheep and goats, has open grazing on communal land which is typical of the area due to the minimal water sources. Freehold farming makes up 72.4% of the land ownership in Namibia, as shown inFigure 22, but this type of land use is not considered ideal because grazing animals confined to fenced in areas do not have access to the limited and inconsistent water sources (DRFN Biophysical and Socio-economics PowerPoint, 2008; Blackie, 2000).

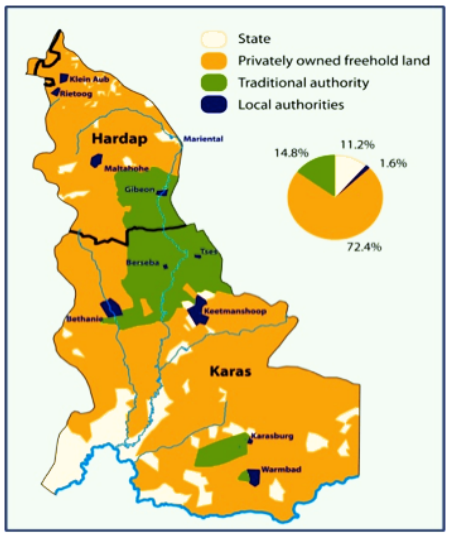

FIGURE 22: LAND OWNERSHIP IN THE FISH RIVER BASIN

Source: DRFN Biophysical and Socio-economics PowerPoint, 2008

Land use and management greatly affect water, which in turn has a great effect on livestock, farming and domestic life. Livestock and irrigation consume the greatest amount of waterin Namibia, and almost all water comes from boreholes and perennial and ephemeral rivers (Davis, 2000). In fact, more than half of the water comes from boreholes. Especially in the Fish River Basin, water is limited and often subsidies are necessary for stakeholders to remain economically viable. Subsidies for water use are a common practice in Namibia because water is necessary to all living things, and is not considered to be affected by economic changes (Davis, 2000). Urban household use gets 67% of its water costs subsidized, and the Department of Agriculture and Rural Development supplies rural and local communities with 19% of their water (Davis 2000).