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Improvement of Sanitation in SRand, Okahandja

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Improvement of Sanitation in 5Rand, Okahandja



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3 May 2005



Improvement of Sanitation in 5Rand, Okahandja

An Interactive Qualifying Project (IQP) Report submitted on 3 May 2005 to the Faculty and Staff of Worcester Polytechnic Institute (WPI) in partial fulfillment of the requirements for the Degree of Bachelor of Science by:

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Report submitted to:

Professor Bland Addison, WPI

Professor Stephen Weininger, WPI

Mr. Vincent Sazita, Okahandja Municipality

Mr. Mbahupu Tjivikua, Polytechnic of Namibia (PoN)

Executive Summary

Informal settlements in developing countries around the world face similar problems of alcoholism, rape, abuse, crime, and unhygienic living conditions. Many towns and cities in the country of Namibia (see *Map 1*) have informal settlements resulting from low employment in rural settings, which pushes families to more urban areas. Okahandja, 70km north of Windhoek, is a town of nearly 20,000 that contains four such informal settlements. Of the settlements in Okahandja, 5Rand is the oldest, and therefore expanded without any organized roadways or electricity. Additionally, 5Rand contains no sanitation or sewer system, and no immediate plans to implement one. After observing the conditions of 5Rand and conferring with the acting CEO of Okahandja, Mr. Vincent Sazita, we focused our project on developing a set of recommendations for the improvement of sanitation in 5Rand, Okahandja.

We arrived at and accomplished our recommendations through the completion of three objectives:

1. Assessing the current sanitation conditions in 5Rand, Okahandja.
2. Researching options for toilets, building materials, and educational programs.
3. Determining the best options for sanitation improvement and recommending them to the Okahandja Municipality.

In order to complete our first objective, we met with Mr. Sazita and additional members of the town council to learn their analysis of the situation. Underlying the social issues already mentioned are many infrastructural problems in 5Rand, including a lack of

sanitation. Traveling into 5Rand provided visual evidence of the poor living conditions. Makeshift pit latrines, as well as the surrounding trees and bushes, are used as toilets in the settlement. Available citizens of 5Rand were interviewed, as well as teachers from the newly constructed school, who said that many children miss classes because of sickness due to these unsanitary conditions.

After gathering information from the residents and the town council, it became clear that the best way to help the people of 5Rand would be to focus our efforts on making a plan for improved sanitation. Subsequent to deciding specifically on sanitation, a meeting with the elected representatives of 5Rand was organized to discuss ways to meet the project goals. Our group raised the topic of improving sanitation in 5Rand, to which the representatives responded with conviction that they wanted flush toilets for each individual household. Furthermore, when the subject of dry toilets was brought up, we learned that there were many misconceptions about dry toilet use and technology. The representatives indicated that dry toilets signify a lower class and that they smell because the waste is not flushed away.

The second issue that the representatives were adamant against was any suggestion to use communal toilets. The representatives insisted that communal toilets would never work in their settlement because there would be no sense of ownership of the facility, and therefore no one would clean it or protect it from vandalism. Also, since the occurrence of rape is unusually high in 5Rand, communal toilets pose a danger to women and children, especially at night. After this exchange of ideas, we expanded our recommendation to not only include the best option for toilets and infrastructure, but to

also propose solutions that would address the misconceptions associated with the toilet options.

After arriving at the decision to address the lack of sanitation in 5Rand, our second objective was to research options for toilets and building materials necessary for making a structure to house the toilets. We visited the Habitat Research and Development Centre (HRDC), an organization dedicated to energy conservation and energy efficiency. The head of sanitation for the HRDC, Mr. Andreas Wienecke, gave us a tour of the facility, as well as explanations of the many models of dry toilets that are currently in use at the HRDC. Mr. Wienecke also shared with our group some of his experiences from working with settlements; people often want wet toilets and then are unable to pay for the water needed to flush them. Along these same lines, Mr. Sazita told us that, on average, citizens of 5Rand spend as much as 70% of their monthly income on water. People can hardly afford water for drinking and washing; expecting them to pay extra for flush toilets would be unrealistic.

In addition to giving us valuable information about dry toilets, Mr. Wienecke offered to host representatives of 5Rand at the HRDC. We brought two representatives and one member of the Okahandja council to the HRDC where Mr. Wienecke gave them a tour and explained the technical details of the dry toilet concept. At the end of the day, the misconceptions about dry toilets were met: the representatives said that if they were given a dry toilet, they would use one.

After we researched toilet options, we looked into building materials that could be used to make the structure around the toilets. In order to get an idea of the type of structure that should be built, we visited Okahandja Park 1, a settlement in Windhoek

where dry toilets have already been put into place. We measured the dimensions of the structures surrounding the toilets to use as a model for our own cost analysis. The Acting CEO of the town council, Mr. Sazita, explained to us that there are many construction companies in Okahandja, and that if possible they would like to use local businesses in order to aid their economy. We met with the owner of Makalani Bricks to get the prices for all of the various models of bricks that they manufacture. Then we went to Okahandja Wire and Steel to get prices for corrugated metal and steel. To give the municipality an idea of the prices of materials outside of Okahandja, we visited Builder's Warehouse in the Northern Industrial section of Windhoek.

After all of our assessment and research, our third objective and goal was met by recommending the best plan for improving sanitation in 5Rand, and presenting it to the Okahandja Municipality. Our recommendations are for individual, dry toilets to be implemented in the settlement. Specifically, we recommend that the Enviro Loo be used, partly due to its success at the HRDC. This model also has the most advantageous features of any of the dry toilet options. Overall, it has no smell, few maintenance requirements, and is simple to use.

In addition to implementing the toilets and infrastructure, we feel that an educational program to teach residents how to use and properly maintain their toilets is essential. Most people who have never been introduced to proper toilets have very little idea how to use them. The program must include what can and cannot go into a toilet, as well as how to empty the dry compost container when it is full. An educational program will ensure that the toilets will be taken care of and that this improvement in sanitation will be part of the long term development of 5Rand.

Aside from the sanitation endeavor we looked into applying to Sister Cities International in order to find a sister city for Okahandja. We found that membership to Sister Cities International would cost the town of Okahandja N\$1980. A sister city may have long-term benefits for the town including economical and cultural improvement. Any improvement that Okahandja achieves will indirectly benefit the people of 5Rand. Through the short-term goals of improving sanitation, as well as the long-term advantages of having a sister city, the lives of the citizens of Okahandja, specifically 5Rand will be bettered.

Authorship Page

All portions of this project, including research, writing, compilation, and presentation were made through equal contributions by Andrew I. Gagnon, Nebiat Kidane, and Stephanie M. LaPointe.

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Andrew Gagnon, Nebiat Kidane, and Stephanie LaPointe

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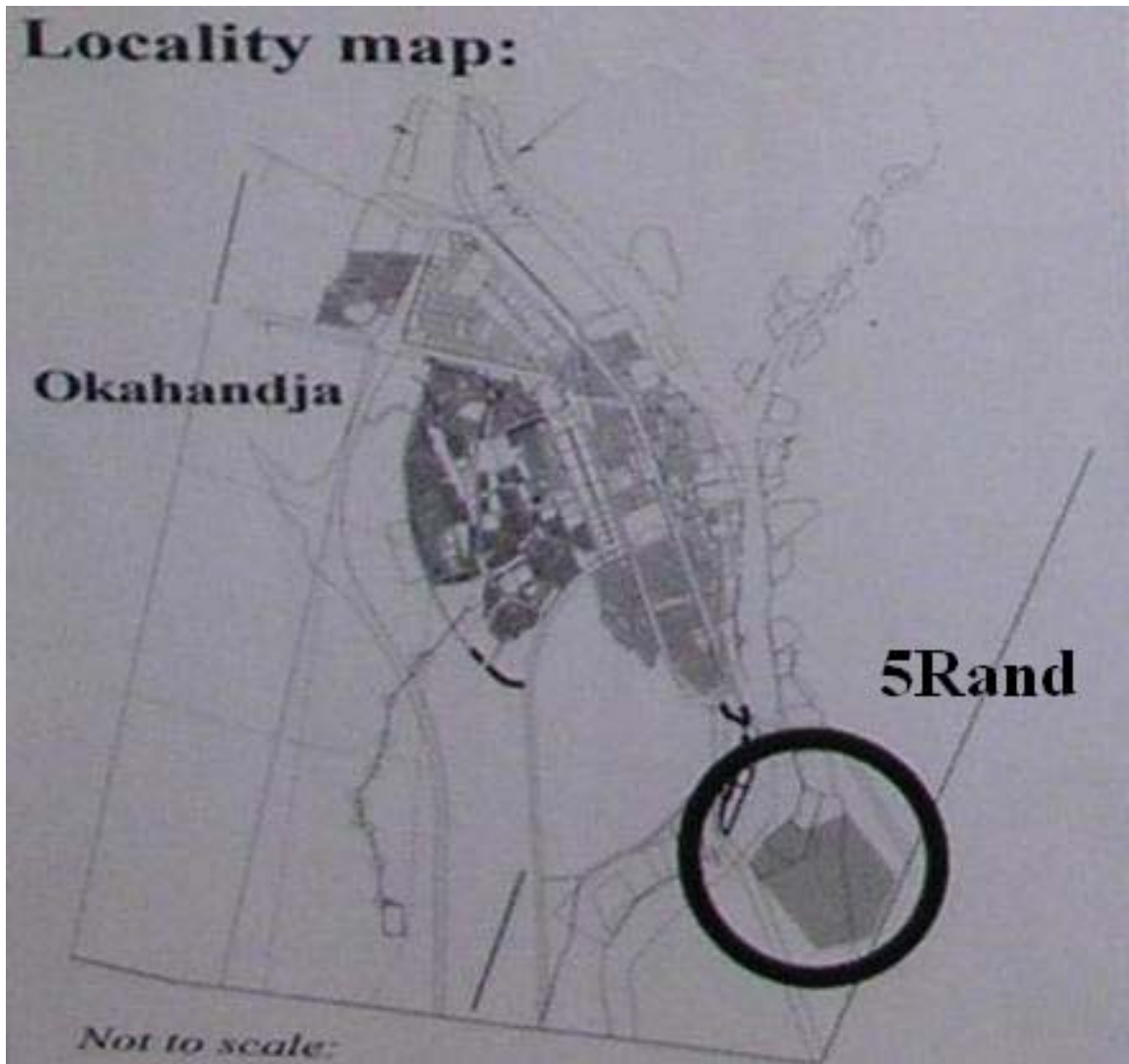
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Map 2: Okahandja locality map, showing the informal settlement of 5Rand.

Chapter 1. Introduction

A major socio-economic problem in many developing nations is the unemployment, crime, and unsanitary conditions of shanty towns surrounding major cities. Shanty towns, or informal settlements as they are called in Namibia, are created by people flooding into the cities in order to find work because making a living in the countryside is no longer a possibility. The cities in the developing world have been inundated with people in search of work, and often there is none available to those in need. Since a shanty is cheap to construct, being made of scrap metal and plastic, people with little or no income construct them and form small communities that eventually grow into informal settlements. Informal settlements usually have no electricity, organized sewer systems, or access to clean water. This lack of infrastructure underlies many social problems such as alcoholism, crime and vandalism, and HIV/AIDS.

The town of Okahandja, Namibia, is a small town with the potential for economic improvement; however, with the growth of the town has come an alarming increase in the population of its informal settlements. Within the last year the population of the most recent settlement, Osheti 1, increased so greatly that the settlement had to be expanded into two new settlements, Osheti 2 and Saamstaan. Currently, there are plans being made for the resettlement of all of the people in Osheti 1, Osheti 2, and Saamstaan into semi-permanent housing. In addition to the aforementioned three, there is an older informal settlement called 5Rand that has been in existence since before Namibian independence in 1990. Since it is the oldest and most permanent of the informal settlements, putting our efforts toward 5Rand is the most effective because of its stability.

5Rand was established when a wealthy property owner began renting plots to settlers at a cost of 5 rand per month (the rand is the unit of South African currency, equivalent to the Namibian dollar). Eventually, the property owner donated the land to the municipality and the renters remained, turning the land into the informal settlement known today as 5Rand. Currently, residents have gained amenities, such as limited electricity and access to clean drinking water; however, a lack of a sewage system and other infrastructure results in poor living conditions. The residents now use prepaid water cards that are inserted into communal water taps to obtain a measured amount of water. Also, there are plans for electricity to be installed in all areas of the settlement. Efforts to improve education have also been made; this year a school for grades 1 through 8 was opened. Despite these advances, there are still many social problems within the settlements, including crime, alcoholism, and rape.

It is obvious that these social problems need to be addressed in order to improve quality of life within the settlements, but we feel the first step toward helping the settlers is to start with underlying infrastructural deficiencies. There is no organized sewage system in 5Rand, forcing citizens to urinate in homemade pits behind their individual dwellings and to defecate in nonspecific areas out in the bush. This lack of sanitation results in bacterial growth that leads to sickness, especially in children.

The project proposes the development of a human waste management system, which takes into consideration the views of the residents of 5Rand, as well as the opinions and views of the town council, to ensure that the needs and desires of all parties involved are being addressed as thoroughly as possible. The arid climate and water scarcity in Namibia is taken into account when making recommendations. Improving the

infrastructure in 5Rand is one part of a long term process of solving more complex social problems.

Okahandja has additional problems that could, over time, be helped by having a sister city relationship with a developed city. A sister city could provide economic and social ties, as well as guidance on the subject of further urban development. In order to find a sister city, Okahandja will have to decide whether or not to become a member of Sister Cities International, a non-profit organization aimed at matching cities with similar needs, wants and interests.

Chapter 2. Background

In this chapter we will focus on the issue of sanitation, more specifically on methods of human waste management that will be beneficial to the people of 5Rand, Okahandja. Misconceptions having to do with sanitation exist among the citizens of 5Rand; therefore, an educational program addressing these misconceptions would be important for the citizens. Developing a relationship through Sister Cities International may provide long term solutions to additional problems in Okahandja. An alliance with a developed city will provide Okahandja with economic and cultural ties as well as guidance in further urban development.

Sanitation

Informal settlements around Namibian cities often contain several thousand residents and not nearly the amount of water or sustainable income required to support the population. The result of these inadequacies is that almost all income goes toward supporting the peoples' needs: 70% of income is used for the purchase of water alone, and the rest goes towards food and clothing (Personal Communication, Sazita, March 2005). Some households barely have enough income to meet their basic needs for survival, let alone have money left over for hygienic sanitation facilities.

Residents themselves do not make sanitation a high priority. A study done in 2000 showed that an average of 94% of the population in southern Africa does not have access to proper sanitary conditions; this information has led to increased efforts to improve these conditions within informal settlements (Manase, 2000). The majority of sewage

systems in southern African settlements are latrine pits. Latrine pits are holes dug in the ground where people defecate, producing large quantities of excrement that are left in the open, with no system for waste removal or treatment. This lack of waste management is dangerous because the excrement which contains bacteria can be transferred to humans, especially children whose immune systems are highly susceptible to disease. The situation in 5Rand, where defecation is done in random areas such as the bush, is equally dangerous to the health of the residents.

Illnesses Caused by Poor Sanitation

Inadequate sanitation is the cause of many societal problems in Namibia, such as: low life expectancy, child sickness, loss of productivity, and disease. The overall drop of the nationwide life expectancy from 48 years in 1970 to 44 years in 2003 can be directly attributed to overcrowding and exponential growth in informal settlements (UNICEF, 2005). The UN clearly states that proper health, water, and sanitation contribute directly towards an increased life expectancy. 2002 statistics showed that only 14% of the rural population Namibia was using adequate sanitation facilities. These data make it clear that sanitation is one of the largest struggles facing the nation (UNICEF, 2005).

In most informal settlements, such as 5Rand, individual shacks have small, personal pit latrines in their backyards. These latrines create breeding grounds for disease that are in close proximity to the shacks. In addition, there are diseases caused by drainage of raw sewage directly into the immediately surrounding soil. Human waste is easily trafficked among pit latrines, between sewage leaks, and around all other areas inhabited by the informal settlers. Once human excrement and bacteria escape their given constraints, the combination of poor sanitation and lack of hygiene quickly generates disease.

Dr. Khadidiatou Mbaye, the officer in charge of the World Health Organization (WHO) in Namibia, says that “155 children die every hour in Africa from water, sanitation, and hygiene related diseases” (<http://www.economist.com>, 2005). In Namibia, government funded immunization programs pay for 100% of shots for children. However, this does not mean that all of the children become immunized; UNICEF (2005) reports that only 70% of children are immunized (as of 2003) against tuberculosis, DPT3, polio3, and measles. There are so many children with compromised immune systems because of inadequate immunizations; additional strain on the immune system, by feces-related bacteria, often results in serious illness or death.

WHO (2000) states that, worldwide, nearly 3 million children die each year of dehydration related to diarrhea. Dehydration is related to any of the many forms of diarrhea, and diarrhea in third world countries is almost always a direct result of improper sanitation. The primary school teachers we conversed with in 5Rand spoke adamantly about how poor sanitation contributes directly to many children missing class time. Even children who have been immunized are susceptible to bacterial infections and diarrhea. Unfortunately, most of 5Rand’s children are not well nourished and their immunization status is at best unreliable, putting them at a high risk for illness. The same teachers told us that for the benefit and improvement of the community as a whole, an adequate sanitation program must be put into place.

Since none of the people of 5Rand have access to proper sanitation, which leads to sickness and incapacitation, the productivity of the population as a whole is declining. Constantly battling sickness and cleanliness issues, as well as the crime and depression already present in informal settlements, makes it difficult to maintain steady employment.

35% of people in Namibia live on less than US\$1 per day (UNICEF, 2002). This amount is not even enough to buy food, let alone toilet paper and soap. With diarrhea and other sewage-born illnesses constantly interrupting day-to-day existence, it becomes difficult to take care of and provide for oneself and one's family. To improve the overall quality of life in the informal settlements, the initial step will be to introduce adequate sanitation systems.

Compromising to Find a Solution

The main problem that contributes to poor sanitation within informal settlements is a lack of resources available to those in need. In 5Rand, water bills are already so high that additional billing for sanitation may become burdensome for the citizens. An example of this forced payment for additional water is happening in South Africa. The South African government insists on installing flush toilets and water borne sewers, even though water is neither readily available nor affordable in most cases (Manase, 2005). The government imposed solution does not work because residents of the settlements are not willing to use their already meager income to pay for the water needed to flush toilets. Instead, residents simply do not flush, which leads to the toilets becoming glorified latrine pits.

To avoid counter productive measures being taken in 5Rand, the needs and resources of the residents must be taken into consideration. The residents already pre-pay for water using cards that are inserted into the water stations, and they will most likely be unable to pay extra for flush toilets. Therefore, the solution may be a compromise using some form of dry toilet which will require no water, and will ensure an increase in

cleanliness. The issue of water payment is not the only reason to take the opinions of the residents into consideration. There may also be cultural and social concerns within the settlements that may interfere with the desire of the people to use any facilities, should they be established.

Addressing Public Opinions of Sanitation

Developing effective solutions for sanitation problems requires consideration of the community's social and cultural norms. Sanitary programs are often introduced by outsiders, such as NGOs or government officials, without any consultation with the residents. This leads to the misuse of the facilities. In Maharashtra, India, public latrines were put into place but the citizens are using them as storage sheds (UNIS, 2005). To prevent such misappropriation of facilities, groups that seek to improve third world sanitation should analyze the cultural and social structure present in the community and take them into consideration as part of the implementation of the sanitation programs.

Addressing Misconceptions about Sanitation

Sanitation is a topic about which the general public does not have much knowledge, therefore many misconceptions arise. In 5Rand, for example, the residents do not want dry toilets in their settlement because some believed all dry toilets are unhygienic and produce odors. They also believed dry toilets are for people of a lower class (Interview with 5Rand representatives, 2005). Ensuring the success of a sanitary program in a community such as 5Rand requires an education program that will address these misconceptions (World Wild Life, 2005). Additionally, the toilets must be

presented in a way that will appeal to the residents, so that they are used for their intended purpose.

Involving the Community

Establishing successful sanitation programs requires involving the community in the design as well as the implementation process. Bangladesh did just that with several of its informal settlements. In this approach, the UK Institute of Development Studies, in collaboration with the Village Education Resource Center, went to the settlements and determined locations where citizens were openly defecating (Ka, 2005). This embarrassed the communities and therefore served as a motivating force for the citizens to become involved in the sanitation programs. The settlement developed the WATSAN (Water and Sanitation) Committee to work with the residents to develop individual toilets. Each toilet was designed differently, depending on the individual's means of payment. As a result, 20 low cost models were developed. Involving the community was a crucial part in the success of this project. Similarly, keeping in constant contact with the needs and wants of the people of 5Rand was a vital part of our project.

The Need for Privacy and Safety in Sanitation

Privacy and dignity are fundamental to the culture of personal hygiene. In Bangalore, India, woman relieving themselves in public is taboo. With the lack of resources available for women to use a bathroom privately, they were forced to control their bodily functions during the day, relieving themselves only after nightfall. Women would remain thirsty and hungry during the day so that there would be no need to expose themselves. Segregated communal toilets were developed in the community to promote

privacy and security for women. Members of the community were willing to pay for the use of these facilities in return for protection against rape, a problem in the informal settlements of Bangalore. This example shows that the need for women to be safe and have privacy is important to successful sanitation improvements. These needs were addressed when forming our plan for the sanitation system.

Finding a Sister City

As Okahandja continues to grow, the municipality believes that having a sister city with which to exchange business knowledge and community development strategies will be beneficial. The task of our group was to assess whether a sister city would be advantageous to Okahandja economically and culturally.

What is a Sister City?

The credit for the concept of a sister city is usually given to former President Dwight D. Eisenhower, after his proposal in 1956 of a program that would unite people across the globe. The program was aimed at developing relationships between people in different countries that would promote a broader understanding of cultural differences, and thus help create world peace (Cremer, 2001). Currently, there are thousands of cities around the world with “sisters.” Sister Cities International, the non-profit corporation that handles most sister city inquiries and matches for cities within the United States, represents 2,500 communities in 126 countries (Sister Cities International, 2005).

Alliances Based on Mutual Benefit

Originally, sister cities were developed in order to foster international friendship and cultural exchange. More recently, however, there has been a shift toward partnering with cities in order to promote economic as well as social growth (Cremer, 2001). Non-profit organizations such as Sister Cities International require dues from potential sister candidates. This means that local businesses have to sponsor and support the idea of a sister city. Having the support of businesses ensures that adequate funding will be available to support the program. This is not to say that the cultural aspect of the sister city relationship has become obsolete; in fact, many sister cities thrive on the exchange of students, who gain cultural experiences and knowledge.

Features of Successful Relationships

There are many factors that go into a successful sister city relationship. The first is an initial person-to-person link. Programs such as student exchanges are pivotal for peaking interest and creating preliminary ties to the sister city. The second important factor in creating a strong connection is the involvement of political figures, including the mayor or city council members. Having the support of city officials is essential in the relationship because it shows that the affiliation is being taken seriously and that both sides are fully committed to the alliance. “Often cities pair up because of some commonality- they are either ports, or resorts or have common manufacturing or industry. They can also advise on the process, and put you in touch with other pairs which are university based. You can have major projects taking place in universities, but on the highest level, if it is really a sister city relationship, you want to have the city halls signing on,” said Suzanne Pearce, a member of the Cambridge Peace Commission (CPC).

The CPC is in charge of the Cambridge-Yerevan alliance. To keep the relationship growing, there is a need to create and develop programs that benefit both parties; having funding for the various programs that are proposed to be run between the two cities is vital. Finally, “Whatever you do, you have to create a diverse citizens’ group to do the actual work and keep it going” (Pearce, 2005). Support from the community is important because the citizens are the ones who will be doing the exchanges and the cultural exploration. Therefore, the people must be interested in the city with which they are being affiliated.

Sister City Case Studies

By studying current sister city relationships and determining what makes a successful alliance, we were able to recommend a plan for Okahandja to follow when applying for a sister city of its own.

A Committee of Volunteers is Important

Cambridge has an enthusiastic and outgoing committee made up of citizens of the city. This is the first essential part of having a successful program. In 1987, Cambridge, Massachusetts became the sister city of Yerevan, the capital of the Republic of Armenia. The relationship came about as a result of a grassroots movement by the citizens of Cambridge to promote world peace by forming an affiliation with a city in the Soviet Union. A city-funded group called the Cambridge Peace Commission was in charge of heading the project. The alliance with Yerevan did not come easily because of the size difference between the two cities. Yerevan has a population of one million, whereas Cambridge has just over one hundred thousand. In initial correspondence, the Mayor of Yerevan was resistant to the idea. Only after the Peace Commission reminded the mayor about the academic community that was based in the Cambridge, such as Harvard and the Massachusetts Institute of Technology (MIT), was the mayor much more willing to talk about the match (Pearce, 2005). “Ironically, the universities have not played a large role in our programming. We certainly can move in that direction. But typically, academics make their own specialized relationships” (Pearce, 2005). Being a small city, Okahandja may also find itself at a size disadvantage, but by focusing on the best aspects of the area, such as the natural hot springs and it will be able to prove its desirability to a prospective sister.

The sister city relationship formed by these two cities became known as the Cambridge-Yerevan Sister City Association, Inc. (CYSCA). Soon after forming, the CYSCA joined Sister Cities International, which has since funded many of the new educational programs forged by the CYSCA. Some programs that have been of great benefit to Yerevan include a teacher training program in 1998 where 980 teachers in 56 villages received training in conventional education, as well as a program in 2002 where several entrepreneurs and tourism specialists from Armenia visited Cambridge for training and internships. Additionally, Cambridge has sponsored aid drives during times of need in Armenia. After an earthquake in 1988, Cambridge sent relief; they also delivered 2 tons of school supplies in 1998 (Cambridge-Yerevan Sister City Association, Inc., 2005). Okahandja has many schools that are in need of supplies, and would benefit from programs similar to those in Yerevan.

The level of involvement between these two cities is an ideal example of a situation that could be beneficial to Okahandja. The key point to be made is that in order for Okahandja to have this type of success in an alliance with another city, there needs to be an abundance of support from the government. A dedicated group of citizens who are willing to donate the time and effort is also needed in order to ensure that programs like those between Cambridge-Yerevan will be put into action.

Relationships Based on Temporary Situations are Not Likely to Endure

Sister city alliances that are not based upon common interests and goals will not be successful. The sister city relationship between Saint Paul and Lawaaikamp, in 1988, was launched in order to protect the citizens of Lawaaikamp from the repercussions of apartheid. The citizens of Lawaaikamp were ordered to leave their small town so that

white settlers from George, South Africa could move in. Concerned citizens in Saint Paul acted quickly and allied themselves with Lawaaikamp in a sister city bond on 23 February 1988. Unwilling to involve the United States in this dispute, authorities in George made no move to attack Lawaaikamp on 31 May 1988, the day set as the deadline for the town to move (Saint Paul's Sister Cities, 2005).

Since the forging of the alliance in 1988 there have been only a few exchange programs that seem to benefit Lawaaikamp; however, the opportunities for future cooperation are still largely unexplored. In April of 2002, twelve years after the initial alliance was made, the first women from Lawaaikamp to become involved in the exchange program made a visit to Saint Paul. Two teachers from one of the elementary schools visited for eight weeks in order to observe and assist at a local St. Paul elementary school. Before the teaching exchange there had been three visits of administrators from Lawaaikamp who studied government and community development (Saint Paul's Sister Cities, 2005).

Relationships based on temporary circumstances are not likely to last. The Saint Paul-Lawaaikamp relationship was formed because of an emergency situation rather than common interests. Their program has not been nearly as successful as Cambridge-Yerevan. When applying for sister city status, Okahandja will want to define clearly what they are looking for and what they have to offer in order to form a successful match. Ensuring that the relationship will be based on sustainable interests is prudent for making lasting alliances.

Lack of Governmental Support leads to Difficulty in Sustaining a Relationship

Support from city officials is an important aspect to a successful sister city relationship. Having the backing of the mayor for the alliance gives the partners confidence as well as potential financial support, should the need arise. The city of Worcester, Massachusetts has maintained an alliance with the city of Pushkin, Russia since 1991 without the collaboration of the mayor or city council. The alliance is maintained through the International Center of Worcester (ICW), a non-profit organization with fifteen people on the board of directors and about one hundred fifty volunteers. Worcester-Pushkin has been successful because of the dedication of the members of the ICW to raise funds and awareness for Pushkin. A few programs, such as an artist exchange and a business exchange, have been achieved despite limited support from the city council. Royce Anderson, president of the ICW, said in an interview that insufficient support from the mayor has made the expansion of Worcester-Pushkin projects very slow and frustrating. Many projects that would have been beneficial to the relationship have been rejected because of a need for funding or manpower that the mayor refused to supply.

The interview with Mr. Anderson revealed additional information that is helpful in our endeavor to assist Okahandja in obtaining a sister city. In order to find a city that matches its interests and needs, Worcester became a member of Sister Cities International (SCI). The dues for the city, whose population is one hundred sixty thousand, are US\$800 per year. After being paired with Pushkin, the ICW let its membership with SCI lapse because of a general feeling that SCI was going downhill as a corporation. Mr. Anderson did convey that in the past five years the organization has turned itself around and become highly credible, and Worcester is therefore considering becoming a member once more.

The example of Worcester-Pushkin is valuable to Okahandja because many useful issues have been addressed. First, having the complete backing of the city council will have to be highly encouraged, before any search for a sister city can begin. Second, any city that becomes a candidate for an alliance with Okahandja must have the support of their local governmental. Finally, Worcester and Cambridge had successful matches made by SCI, and SCI has also funded some of the projects between Cambridge and Yerevan. SCI has many resources for researching a suitable match that are not available in Okahandja, and will therefore be a practical means for obtaining a sister city.

Chapter 3. Methodology

The goal of this project was to recommend the best options for a toilet infrastructure in the informal settlement of 5Rand, Okahandja, where an increase in population and lack of facilities has created unhealthy living conditions for the residents.

In order to achieve our goal, our team set the following objectives:

1. Assessment of the current sanitation conditions in 5Rand, Okahandja.
2. Research of options for toilets, building materials, and educational programs.
3. Determination of the best options for sanitation improvement and recommending them to the Okahandja Municipality.

Assessment of Sanitation Conditions

By evaluating the sanitary concerns that currently exist in 5Rand, we were better prepared to recommend a plan for the improvement of the informal settlements. Our initial activities included personally observing the sanitation conditions in the settlement and photographing situations that defined the current environment. We asked our liaison to introduce us to the most influential people in the settlements. This led to a meeting with the 11 elected representatives of 5Rand. The information gathered from the interviews provided us with the opinions, desires and needs of the residents. The meeting also served as the first step to establish trust with the representatives and the community. Trust was vital to our project because it enabled us to develop a comfortable relationship with the residents of 5Rand so that our ideas and presence would be more accepted. Obtaining the opinions of the residents of the settlements was an important factor in

deciding which plan of improvement to propose. Nobody knows more about the pressing issues than the people who live with them every day.

The second part of our study of sanitation included taking photographs. We took photographs that best depicted sanitation problems, including individual pit latrines and homemade facilities. We used these pictures as visual support when conveying our recommendations for improvement.

In order to have a full understanding of the current and future infrastructure layout, we interviewed the Manager of Engineering Services, Beren Kaurimuje, and the Building Inspector, Peter Maletzky. Both engineers held health, building materials and overall cost as high priorities. Since it is the town officials who will approve any spending on the project, having their opinions gave our team a more realistic view of specific improvements to propose.

Research of Options

The proposal of our model was based on the outcomes of our assessment of current sanitation conditions, as well as initial research completed both in Windhoek and in Worcester. While in Windhoek, we researched local case studies and surrounding companies. The arrangement of a meeting with Andreas Wienecke from the Habitat Research and Development Centre (HRDC), an expert in the area of sanitation and alternatives to flush toilets, provided us with information on currently available products. Using the information that we gathered, as well as further background research, we compiled recommendations for implementation of a sanitation system in 5Rand.

In collaboration with the Habitat Research and Development Centre, we brought two representatives of 5Rand and one town council member to Windhoek to the HRDC.

An instructional and informational session on the proper construction and use of dry toilets was given to the representatives. The representatives were allowed to use and smell the dry toilets, helping to disprove several of their misconceptions.

In order to recommend sources of building materials and to promote investment in local business, we visited Okahandja's Makalani Bricks, Coetzee Drilling and Earth Moving, and Okahandja Wire and Steel. At each of these locations, we explored options for construction materials and pricing schemes. Though some of the local prices were higher than those from Windhoek or South Africa, the town council was adamant about not only supporting local business, but employing local laborers as well. Our end result from the interviews with these companies included a cost and building material analysis.

Sister City Initiative

The town council has proposed that acquiring a sister city will assist in its goals for economic development. We have given the town council our research on sister city relationships and suggested that they apply to Sister Cities International (SCI). We researched the application to SCI and found the price of dues for Okahandja, as well as a section that requires a 100 word description of the town. It will be up to the town council to pursue their membership.

Chapter 4. Results

In the following chapter we present our findings in the areas of community education and development, possible toilet options, and cost analysis for building materials. These results were obtained through interviews, personal contacts, and research about construction companies.

Community Involvement

An important aspect of creating a successful plan for improvement of sanitation in 5Rand was assessing and addressing the concerns of the citizens. Since it is the people of 5Rand who will eventually be impacted by our plan, we made every effort to take their personal and cultural values into consideration.

After interviewing the appointed representatives of 5Rand on 29 March 2005, we were able to identify some common concerns among the people. The most prominent issue was the determination of residents to have flush toilets and water borne sewers. When we tried discussing dry toilets, an alternative to flush toilets, the general response was that dry toilets are for poor people and that the people of 5Rand wanted to have the flush toilets like people in permanent housing. In addition to believing that dry toilets are for the lower classes, the representatives said that they were concerned with the smell that would come from keeping the waste on site and not having it flushed away. Finally, the representatives felt that no one would want to touch the waste when it came time to remove it from the holding tank.

In addition to these concerns about dry toilets, there were many social issues that had to be considered before introducing toilets into the settlement. The representatives

said that communal toilets were not a viable option in their settlement because of the high rates of crime and vandalism. The feeling was that if a communal bathroom were to be constructed, there would be no sense of ownership or responsibility for the facilities. Nobody would clean the area or protect it against vandals. Another problem with communal toilets is that women would feel unsafe using them. Rape occurs at an alarmingly high rate in 5Rand, and women feel that going to a communal bathroom at night will put them at risk. The representatives suggested that the answer to all of the cultural and social concerns would be to give each household its own individual flush toilets.

Field Research

After learning the opinions of the representatives of 5Rand, we met with Andreas Wienecke, the head of sanitation and research manager at the Habitat Research and Development Centre (HRDC), a facility dedicated to sustainable development. Mr. Wienecke was most concerned with the misconception that dry toilets were for poor people. He has seen this scenario many times: people say they are willing to pay the extra cost for wet toilets, the sewers and toilets are then installed, and the resulting water bills become impossible to pay. Mr. Wienecke said that in areas concerned with conservation, dry toilets are the best solution due to the scarcity of water. Dry toilets are also the most economic option, because no matter how willing people may be to pay for the water, the reality is that most will not be able to.

The HRDC uses only dry toilets for its staff, and when we visited the HRDC we found first hand that there was no unpleasant odor. Mr. Wienecke said that during longer

periods of rainy weather, the sun cannot heat the waste enough to eliminate smell, but there are some cost effective options for controlling it. Wheat bran contains certain bacteria that consume the bacteria present in the waste, neutralizing odor as well. A small pinch of wheat bran per week can effectively control odor. A bucket that can easily supply one toilet for a year costs N\$25. Another option is adding a mixture of ash and sand to the waste container. The acidity of the ash also has neutralizing properties, and this solution is free.

The remaining issue about dry toilets to be addressed by Mr. Wienecke was the problem that people will have emptying the toilet containers when they are full. He showed us the mechanism for removing waste from one of the dry toilet models, the Enviro Loo, which will be discussed in further detail later (also see Appendix M). The waste is actually reduced to an odorless powder, and at 5% of its original volume, it can easily be shoveled out and used as fertilizer or simply disposed of in the bush.

We gained more insight into implementing dry toilets into informal settlements by traveling to areas where dry toilets had already been introduced. The city of Windhoek subsidized a project nearly a year ago that placed dry toilets in the informal settlement of Okahandja Park 1. We visited Okahandja Park 1 on 7 April 2005 in order to talk to the residents about the toilets and to see what condition they were in. We were surprised to find that the toilets were all locked and had not been in use since their construction. We interviewed Michael Muyemga, a resident of the settlement, about the current situation. Mr. Muyemga said that everyone thought that the toilets were unsafe, and so they were locked. However, as we soon discovered, no city officials had ever actually communicated that to the residents. Mr. Muyemga also said that confidence in the toilets

has diminished since they were locked and the residents never received an explanation for that action. Mr. Muyemga did mention that if they were ever opened, the people would definitely have reason to use them. Mr. Muyemga felt that the dry toilets were a better option than the current situation, which is having to use pit latrines, but that flushing toilets would be the best option.

Education and Integration Plans for Sanitation

With a new understanding of dry toilets, our group set out to address the misconceptions held by the people of 5Rand. The first step to convincing the community was convincing their community leaders. On 13 April 2005, we arranged for two representatives, as well as a member of the city council, to visit the HRDC and see for themselves how dry toilets work. Mr. Wienecke led the tour, translating most of the dialogue between Afrikaans and English and explaining all available models of dry toilets and their means of odor control. On the ride back to Okahandja, we asked our guests what they thought of dry toilets. How dry toilets are used and the benefits they offer became clear to them, and they appreciated the introduction to this new option. The goal of the day was accomplished: Representatives of 5Rand had seen dry toilets and said that if given one, they would use it.

Since we were convinced that misconceptions about dry toilets could be changed, we focused on the more complicated social concerns about communal toilets. Communal toilets were not looked on favorably because of vandalism; however, the toilets in Okahandja Park 1 are shared among a few households and can be locked. From speaking with Mr. Muyemga, we learned that the residents of Okahandja Park 1 have no objections

to this situation. Another problem with communal toilets is that women would feel uncomfortable traveling alone to them. During a meeting with Mr. Sazita we discussed different security options. One idea that was discussed was to employ one or more security guards from the community, selected by the women. If security guards whom the women trust were to be hired, not only would the women feel safer but more people would be employed. Though these ideas can help make communal toilets a viable option, none of them are guaranteed to solve all problems. Individual toilets for each household would be ideal for the citizens of 5Rand, even though the cost to the town of building and installing individual facilities would be considerably higher than for communal toilets.

Introducing toilets, whether individual or communal, to those who have little or no previous experience with them will be challenging. People cannot be expected to intuitively know what the appropriate use of a toilet is. A team of WPI students working on a project on water management in Windhoek presented information indicating that there were instances of newly installed toilets being used as waste receptacles for old engine parts. An educational demonstration would be beneficial to the people of 5Rand in order to avoid similar confusion. Topics to be covered should include the proper care and handling of the equipment being installed, as well as what can safely go into the toilet.

Introducing toilets to 5Rand may also be a challenge. Some people may object to the type of toilet being installed or to toilets in general. Mr. Wienecke stressed that the most well-known way to successfully introduce new ideas into a society is gradually. He suggested taking up to ten volunteer households and installing the toilets near their homes. Once the success of these test cases can be seen by the community, creating a desire for more, the product can be more widely distributed throughout the community.

Additionally, the people who receive the first toilets will be able to educate others on their use and maintenance.

Toilet Options

In analyzing the options for toilets, we divided them into four categories: communal versus individual facilities, and water borne versus dry toilets. Deciding between communal and individual toilet options must be determined by analyzing and comparing several important determining factors including initial costs, maintenance costs (long term), safety and security, vandalism prevention, cultural concerns, and opinions of the residents who will be using the facilities. These are also determining factors in deciding whether to recommend either a water borne sewer system or a dry toilet option. The information in this section will identify and explain all of the factors and reasoning that contributed to our final recommendations.

Communal Toilets

Communal, by definition, indicates a location or object that is shared among more than one person. In the case of toilets, the word communal indicates a facility designed for use among several households. The residents of informal settlements think that communal facilities of any type, especially toilets, will be misused and vandalized. There is little sense of community in the informal settlements, and the sharing of a facility as private as a toilet will, in their opinion, be unlikely to work.

The advantages of a communal toilet facility make it appear, both financially and technically, to be the best solution. A communal toilet facility will have an initial cost that is much less than an individual toilet. Sharing walls and having a central location

allows for many toilets to be in one place; therefore, the initial cost can be many times lower than if individual infrastructures were built. The number of toilets needed is both directly proportional to the number of people in 5Rand and the chosen toilet's capacity for waste. While having two toilets in a single, divided building may not be practical, eight or ten toilets in a "bank" can provide use for 160 to 200 people (assuming 20 users per toilet).

By having the toilets in a central location, households will all be relatively equidistant from the facility. Construction costs of a communal toilet facility, wet or dry, will also be kept to a minimum. For each additional toilet after the first, the costs of one or more walls may be subtracted from the total cost because the walls between stalls are shared. Excavation costs need only to cover the one large foundation hole, as opposed to many smaller excavations in potentially unreachable or rocky terrain. Materials and labor, as well as machinery, can be kept at a central location, preventing construction teams from being spread too thinly and not having the supervision required for quality craftsmanship.

By focusing efforts on one or a few larger buildings, instead of many smaller ones, the head manager of the project will be able to closely supervise construction. According to the owner of Makalani Bricks, William van Schalkwyk, in order to have high quality results on a construction project, laborers must be supervised at all times. Whereas many individual toilets being constructed at various points throughout an informal settlement would disperse laborers and foremen alike, the construction of only a few communal facilities would help to localize manpower and materials distribution (personal communication, Schalkwyk, April 2005).

Accessibility to town sewer lines is of utmost importance with regards to water borne sewers. The cost of running both water and sewer pipes to and from the communal facility must also be factored into the overall cost of implementing the facility. One of the beneficial parts of a communal facility is that it can be connected to the town sewer and water system with minimal need for laying pipes. A communal facility only requires one set of connections, while each individual toilet per family would have to be connected via its own pipeline. Bertus Coetzee of Coetzee Drilling and Earth Moving indicated that laying pipes, even at low depths, is costly in Okahandja due to the rocky nature of the ground (personal communication, Coetzee, April 2005). While the cost for the installation of piping for a wet toilet communal facility may not be as large as for many individual toilets, it is possible to eliminate the cost by using dry toilet options in a communal facility instead.

In summary, a dry communal toilet facility is advantageous in several ways. The first is that it is not restricted by distance from the town sewer lines. The second advantage is that because sewer and water lines do not have to be dug in the rocky ground, the excavation costs are kept to a minimum. The only excavation costs are associated with the foundation of the actual building and the burying of the waste containers. In addition, the lower initial infrastructure and maintenance costs of a communal facility make dry communal facilities appear the most financially practical option.

Community representatives were not, however, receptive towards the idea of a communal toilet facility, regardless of whether it would be of the wet or dry type. The strongest objection to communal toilet facilities involved crime. Crime in or around these

facilities would, in their words, include vandalism, rape, theft, harassment, and improper use. A communal facility creates a location where women can be specifically targeted while in a vulnerable position. This does not mean that men and children would not have the same problems. In fact, it is becoming a concern that residents of all ages and both sexes would be victims of personal harm. The community leaders of 5Rand were adamant in their views and had personal observation and experience to back it up.

Theft and vandalism are always occurring in areas of high unemployment and low morale. In 5Rand, where 35% of the people are unemployed, many turn to theft as a way to obtain what they need or desire. The construction materials used in communal toilet facilities would be of value for the residents. The most common use of corrugated sheet metal is for homes, and cement buildings are susceptible to graffiti and vandalism. All materials, especially plastics and metals, have value to the residents. The representatives clearly noted that no care will be taken towards the upkeep, and vandalism and theft will continue until the facility has been reduced to rubble, because the residents have no sense of ownership for the facility.

Unintentional misuse of the facility is also possible because many citizens have not used a modern dry toilet or a wet toilet facility before. An educational program is a solution to this, but the implementation of such a program requires time and cost, both of which are not readily available in 5Rand. As discussed earlier, an educational program can help to dissolve misconceptions and correct misunderstandings about both dry and wet toilet facilities. Without this step, any constructed infrastructure, no matter how well planned, will be misused and vandalized.

Initial costs of communal and individual toilet facilities vary greatly due to the variability of construction materials. Assuming that comparisons between communal and individual toilets will be made using the same material, such as corrugated steel sheeting or cement, individual toilets are by far more expensive. As explained earlier, combining several toilets into a larger single building with individual stalls minimizes material and labor. The downside to communal toilet facilities is clearly not related to the infrastructure itself, but to the social issues surrounding their use and acceptance within the community. Educational programs can help to reduce these problems somewhat, but those responsible for the community must be willing to accept potential setbacks. As of now, and at this stage of 5Rand's development, the option for individual toilets must be considered. In order to meet the concerns of residents about crime and vandalism, as well as discomfort and the lack of privacy, it is necessary to consider more expensive options that will have a greater social benefit.

Individual Toilets

Individual toilet facilities that are used by only a few households, or even a single household, were seen as the only acceptable option by the 5Rand representatives. Their reasons for wanting such a facility include reduction in crime, vandalism, misuse, and individual maintenance. Each structure must consist of a small, outhouse-style building with a cement foundation, roof, ventilation, and lockable door. It should be placed on the property of the owner, or at a location central to all of the households taking part in its ownership (see *Figure 4.3*). An individual wet toilet would have its own connection to the town sewer system, while a dry toilet would require its own waste receptacle system.



Figure 4.1: Cool Maintenance individual dry toilet facility constructed in Okahandja Park 1.

The greatest advantage of an individual toilet facility, or even one that is shared among several households, is that the number of people using it regularly is controlled. By having such a small population (i.e. between 10 and 30) using a single toilet, it is easier to educate the residents on the use and maintenance, as well as monitor misuse, of such a toilet. Emptying of waste can easily be rotated among individuals who are either related to each other or are close neighbors, and each person will feel satisfaction in ownership of such a toilet. Responsibility for the infrastructure will be taken by the residents, who are paying for their own facility.

Building individual toilet facilities will require, of course, more labor and materials than a communal facility. Each toilet facility will have a small concrete foundation poured, with its own set of pipes constructed to direct the waste from one toilet to an individual collection tank or sewer connection. The collection tank for a dry toilet will have its own ventilation system and roof. The excavation costs alone for a sewage collection tank, or sewer and water pipes, and the pouring of many, spread-out small concrete foundations will be many times that of a communal facility. Since each structure will be of a smaller size, materials must be divided and delivered to each site. Smaller sections of wall and roofing material must be cut or built, reducing the cost effectiveness of buying in bulk. Rough estimates indicate that the cost of building 20 individual toilets compared with the cost of building one communal toilet facility with 20 toilets, considering only the purchase of bulk wall materials, results in nearly a 2-fold increase in wall materials and thus cost (see Figure 4.4).

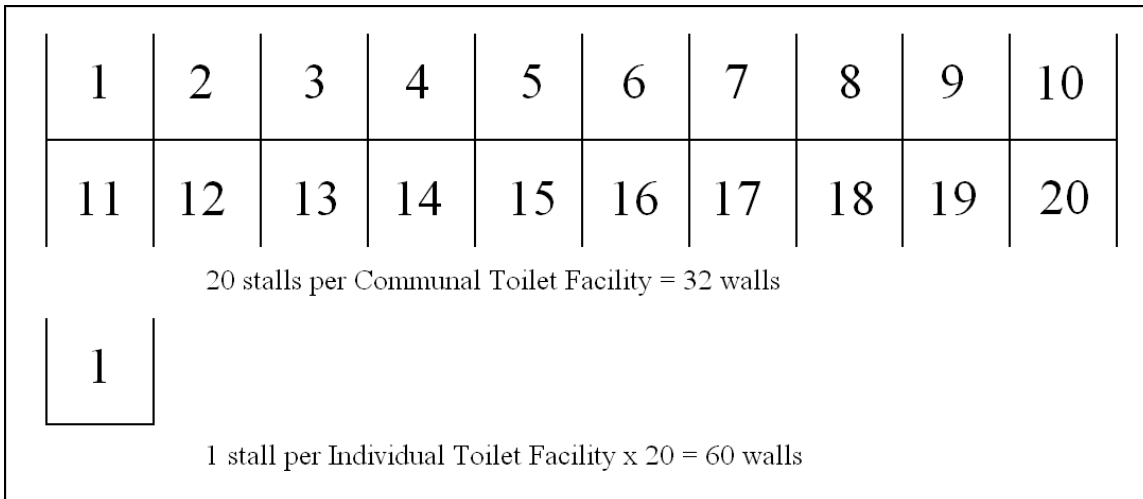


Figure 4.2: Comparison of amount of wall material needed for communal toilet facilities compared to individual toilet facilities.

This brief analysis clearly shows that individual toilet facilities are much more expensive, both in material and labor costs, than communal facilities. For this reason, installation of individual toilets must have important social and long term benefits to the community.

Location of individual toilets is a much simpler process than that of finding several central locations for communal toilets. The individual toilet, if used for a single family or home, must only be placed at a location on the owner’s property. When homes with adjoining property decide to share an individual toilet, it will be placed at the junction between the properties. The responsibility for the cleaning and the upkeep will be left to the residents using it, but again, a strong education program is recommended in order for this to be successful.

Wet Toilet Options

Wet toilets, also referred to as water borne or flush toilets, are connected to the town sewer and water systems. Most systems use a raised holding tank that will flush between 10 and 15 liters of water through the toilet bowl and into a sewer pipe each time

it is used. The water is from the local water supply, and the waste is treated at a local waste management facility. Wet toilets are common throughout developed areas of Namibia, and it can be assumed that educational plans will be needed to inform residents on their proper use and maintenance.

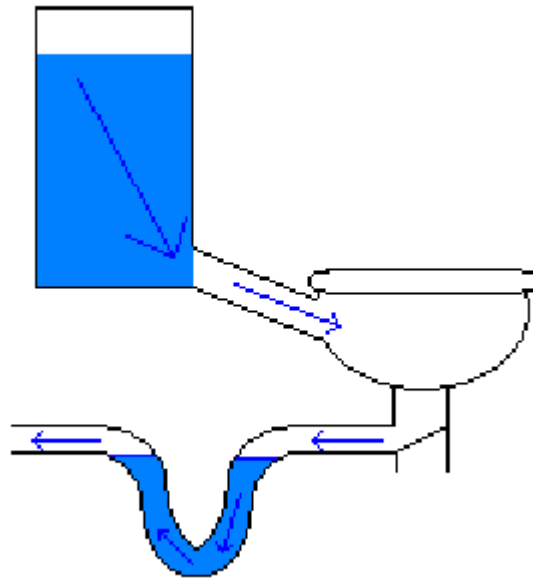


Figure 4.3: Direction of flow in a standard flush toilet with water borne sewer.

In areas of the world where water is abundant and wastewater removal and treatment systems are already in place, wet toilets are commonplace and dry toilets are very rarely seen. Flush toilets have become the standard of living in many areas of Africa, mainly large cities and wealthier areas. There is no doubt that any wet toilet in sub-Saharan Africa is using unnecessary amounts of water, but it has become a symbol of class that cannot be ignored. The representatives of 5Rand, as well as the residents, believed that flush toilets are the only improvement that is acceptable for them, and that any type of dry option will be no improvement over their own pit latrines.

Wet toilets have their own distinct benefits that separate them from their dry toilet counterparts. Wet toilets have a very low initial infrastructure cost, if sewer and water pipes are already located within the vicinity. A plastic or ceramic toilet pedestal, bowl, seat lid, and tank can be bought for under N\$1,000 at Builder's Warehouse in the Northern Industrial area of Windhoek. Flush toilets also incur much lower maintenance costs than dry toilets, if they are installed and used correctly. Properly constructed pipe lines and connections can prevent water and sewage leakage. Correct usage of the flush toilets prevents clogging and flooding of the facility, and the benefit of having the sewage removed to a waste management facility is that the number of uses per day becomes unlimited. There are still limitations on the number of people that a flush toilet is designed for, but that number is purely limited to occupational capacity of the facility, not the size of the underground waste container. Therefore, flush toilets are able to serve much greater numbers of people than are dry toilets.

The main disadvantage of installing a flush toilet revolves around the scarcity of water in arid areas such as 5Rand. With water costs at a premium, and residents having barely enough money to pay for drinking water, it is difficult to justify having them pay for drinking-quality water that is going to be used to flush human waste. While a potentially lower initial cost is a short term benefit to a family or group of individuals, having to pay monthly fees for water to flush the toilet is not advantageous for the long term. Municipalities will often charge for use of the sewer system, on a per month basis, in order to reclaim some of the cost required for installation.

The idea of water conservation and scarcity has to be taught to the residents of 5Rand as a whole so that they will understand the need for dry toilets. This includes the

problem of mismanagement of toilet water, as there have been instances in other informal settlements of attempts at flushing foreign objects down toilets. This is not the only thing that renders the toilet useless; residents will often break the toilet itself in order to gain access to surplus drinking water. Cases have also arisen of young children and teens running the water for hours, resulting in a single monthly bill that causes the family to go broke (personal communication, Wienecke, 2005).

The best way to demonstrate the scarcity of water is by telling the residents that every time they flush the toilet, they will have to pay for somewhere between 10 and 15 liters of water. On top of that, there will also be a monthly fee that covers the waste removal and treatment. The final conclusion is that although the residents are under the impression that they must have flush toilet facilities, the lack of water availability and the high price tag that goes along with it will undoubtedly result in their inability to pay. Our final recommendation is not to use flush toilets and water borne sewers, especially because they relate to social and monetary concerns.

Dry Toilet Options

Dry toilets are a new technology compared to the wet toilets. Dry toilets have become more popular in the past 10 years as water conservation has become necessary. Many dry systems have been hindered in the past by lack of ventilation and problems with drying techniques for urine and feces. Application of modern technology to basic structural materials has done away with these problems, but not without cost. The basic price of a dry toilet is higher than the price of a full wet toilet installation, though the maintenance costs of a dry toilet are negligible.

The basic blueprint of a dry toilet is similar among all of the available options. As a standard, dry toilets have no electricity consumption and have no water requirements whatsoever. Beyond that, the dry toilet consists of an external pedestal and toilet seat very similar in appearance to a standard flush toilet. The only part lacking is the water tank and the connections to the town water and sewer facilities.

The waste container in dry toilets is specially designed to separate the urine and feces, directing the urine towards a separate dehydration portion of the underground waste container. Instead of a conventional flush lever on the tank, a dry toilet has a much longer lever that extends below the toilet bowl. Once the urine had washed down the waste pipe, the lever is pulled, forcing the feces into the main part of waste container in an even manner. The temperature of the waste receptacle is increased to nearly 80 degrees centigrade, which causes the rapid evaporation of fluid waste and the dehydration of solid waste. The result is either a compost bag that is removed or dry compost that can be used as a fertilizer for gardens and lawns.

With several companies producing different variants of this same design, the best known ones must be compared and contrasted, based on the advantages of design and cost to the town of Okahandja and the informal settlement of 5Rand. There are also more educational and practical issues surrounding the use of dry toilets than there are surrounding wet toilets. For this reason, as with options already mentioned, an educational program is mandatory to ensure proper usage and maintenance of any toilet that is provided in 5Rand. That said, dry toilets are the most promising option for 5Rand, especially the Enviro Loo. With the correct planning and implementation, there is

incredible potential for the Enviro Loo to be a complete success. The following descriptions are for the models that we consider feasible for installation.

Enviro Loo

The Enviro Loo, produced by a South African company, has a distributor in Windhoek. With a local distributor to keep the costs to a minimum, and expertise on the toilet nearby, it appears as though it is technically a good option. The actual toilet also has many advanced features that are a result of over 10 years of improvements. Installations of the Enviro Loo can be found locally in Okahandja Park 1 and at the HRDC.

The Enviro Loo consists of a toilet bowl and connecting pipe that are coated in a nonstick manner that promotes waterless flushing. Once the feces and urine have been separated and distributed into the waste container underground, the dehydration process begins. The waste container is half buried externally and constructed entirely of heavy duty black plastic. This color, and the intensity of the Namibian sun, creates temperatures in the waste container that are in excess of 60°C. This results in constant and complete evaporation of all liquid waste inside, leaving behind odorless, bacteria-free compost. By the evaporation of all liquid, the overall mass of the waste is reduced by nearly 95%; this means that an Enviro Loo would only have to be emptied once per year.



Figure 4.4: Interior installation of Enviro Loo dry toilet system at the HRDC.

To prevent odors of waste from bothering people during the evaporation process, a novel whirlybird concept is employed. A black plastic ventilation pipe leads from the

waste container to above the roof line. The combination of high interior temperature and the wind passing overhead creates a backpressure that pulls all odors upwards and away.



Figure 4.5: Whirlybird mechanism used for ventilation of the Enviro Loo.

The most practical version of the Enviro Loo is the 2040 commercial model (see Appendix M). It is designed for use by up to 20 people who each have an average of 3 uses per day. The cost for the waste container, whirlybird, waste separation mechanism and all required pipes and connectors for this model is R3,150 (given in rand, as the model is from South Africa). The high initial cost is unavoidable for all dry toilet systems, but it is outweighed by the long term benefits of low maintenance needs and durability. The town of Okahandja has already taken delivery of 25 Enviro Loos, but has had no guidance or available manpower to assemble and install them, let alone provide education for the families that will be receiving them. The original attempt to install the Enviro Loo ended in failure because only one toilet was offered to the community and they received no direction or rules about the toilet's use. In order to make the Enviro Loo

work successfully for both the municipality and the residents of 5Rand, a detailed education program, divided into manageable parts, must be implemented. The Enviro Loo is highly recommended as the toilet can meet all of the needs and expectations of the residents.

Other Dry Toilet Options

There are many other dry toilet options that were considered, including the Conduit Dry Toilet (CDT), the EcoSan Waterless Toilet System, the Nature Loo, and the Cool Maintenance. They are all viable options, but each lacks the numerous advantages of the Enviro Loo. Instead of complete summaries of dry toilets that will not be recommended, specific reasons for their disqualification will be explained in detail below (see Appendices K, L, and N for more information on specific toilets).

The CDT's main flaw is that it uses a highly complicated removable waste container mechanism for composting waste. Waste bins must be exchanged when one is full of waste. This exchange of bins, and the potential for insect and bacterial growth would not be suitable for a community where the sanitation system needs to be as simple and straightforward as possible.

The EcoSan is similar in construction and design to the Enviro Loo, but the powdered waste that results from the dehydration process is collected in disposable bags, which must then be removed and changed throughout the year. The added complexity of having a bag system that must be periodically checked and replaced is a disadvantage. While it is possible that residents of the informal settlements will be willing to organize bag replacement on their own, it is unlikely that such a rotation of duties will occur.

The Nature Loo is a product of a 10 year old design from a company hoping to market slightly upscale models of dry toilet systems. Many of their models are not practical for addressing 5Rand's needs, but the Classic model has several models that are comparable to the CDT and the EcoSan. Like the aforementioned CDT, the Nature Loo uses a removable waste bin technology requiring the removal and replacement of composting bins when they become full. Along with that, it requires an electrical connection for a fan that will remove unpleasant odors. The goal of the recommendation is to find a toilet that is sustainable, and an electric fan does not meet our standards.

The Cool Maintenance dry toilet has been installed successfully in Okahandja Park 1. Due to the fact that the installation is very recent, the data for its actual achievement is not available. In fact, the residents have not yet gained access to these toilets. The Cool Maintenance is very similar in design to the Enviro Loo. It uses a whirlybird ventilation system that pulls the odors up and away from the toilet, as well as a similar toilet and infrastructure. The main difference is that the Cool Maintenance has a large cement basin underneath, similar to a septic tank, collecting the waste that might then be removed by the municipality. The premise of waste collection without evaporation or composting is not practical for the environment. For this reason, the Cool Maintenance should not be used if there is the possibility of attaining the Enviro Loo.

Building Materials Cost Analysis

Once the appropriate toilet is chosen, a structure must be built to house it. Choosing the right structure for the toilets in 5Rand, Okahandja, is as equally important as choosing the right toilet. The exterior structure provides privacy and security that is

vital to the success of the proposed sanitation plan. When selecting the proper structure, factors such as building material, affordability, and labor cost must be taken into consideration. This section includes cost analyses of the building materials available in Okahandja.

Conducting a proper cost analysis requires at least one variable, such as price building material or quantity, to serve as the control. Prices change depending on building material; therefore, in order to make an accurate comparison, dimensions of the structure must remain constant. The dimensions we will be using are 1.97m by 1.45m by 0.91m (See *Figure 4.6*). These dimensions were obtained from a similar sanitation plan that was set up in Okahandja Park 1. In Okahandja Park 1, different models of dry toilets, including the Enviro Loo, were implemented. Surrounding these toilets were corrugated metal structures with the above dimensions. The structure allows for one person to fit in comfortably and requires few building materials.

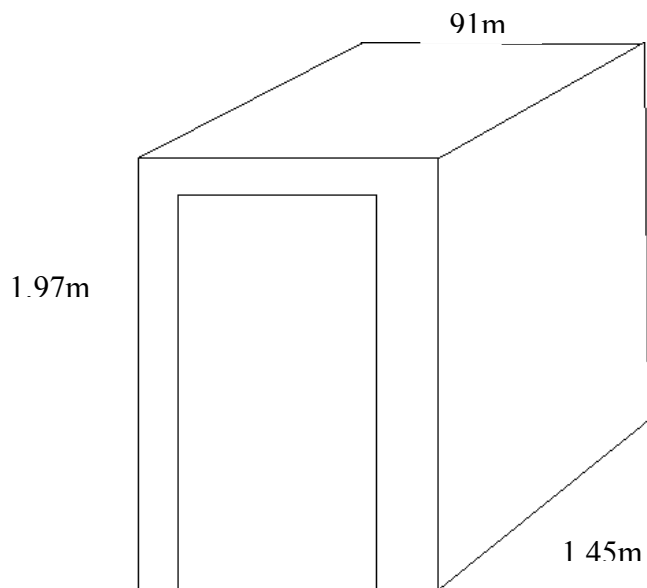


Figure 4.6: A model for structure to be used in 5Rand (left), and a Cool Maintenance dry toilet structure from the informal settlement of Okahandja Park 1.

The building materials we considered were brick, corrugated metal, and cement. These specific materials were chosen because they are locally available. Makalani Bricks provides bricks, and Okahandja Wire and Steel provides corrugated metal. It is important for the Municipality of Okahandja to use local companies because transport cost can be kept minimal; it will also benefit the town's economy.

Bricks Comparison

Makalani Bricks is the provider of the bricks considered in our cost analysis. There are three types of bricks available: block bricks, super bricks, and standard bricks. They vary in size, as seen in *Figure 4.7*. The dimensions of the block brick is 450mm by 230mm by 150mm. The super bricks have dimensions of 220mm by 100mm by 100mm. The standard brick is the smallest, with dimensions of 220mm by 100mm by 70mm.



Figure 4.7: Comparison of block, super, and standard bricks from Makalani Bricks.

The block brick, the largest brick, is also the most expensive. It costs N\$8.48 per brick with an upfront payment in cash. If the 30-day payment plan is used, the price increases to N\$9.45 per brick. The super bricks are less expensive but they are also smaller. Makalani Bricks sells the super brick in packages of 1,000 for N\$1,468.76 (N\$1.47 per brick) if cash is the method of payment. The price increases to N\$1,602.89 (N\$1.61 per brick) when the 30 day payment plan is used. The standard brick is also sold in packages of 1,000 for N\$1,121.06 (N\$1.12 per brick in cash) and N\$1,249.98 (N\$1.25 per brick) for the 30 day payment plan.

The information above was used to determine the cost of one structure using each brick. Building the structure with block bricks would require a total of 144 bricks, which would come to a total cost of N\$1,221.12 if the bricks were purchased with cash or N\$1,360.80 if the bricks were purchased with the 30 day payment plan. Because of their smaller size, one would need 492 super bricks to build the structure. The total cost of building with super bricks is N\$723.24 with cash payment and N\$792.12 with the 30 day payment plan. The dimensions of the standard brick are similar to the super brick, except that they differ in thickness. The standard brick has a thickness of 70mm, which is not enough to ensure stability. To increase stability a double wall of standard bricks must be used. Therefore, when building with standard bricks a total of 984 bricks would be

needed. The total cost is N\$1,446.48 with payment in cash and N\$1,584.24 with the 30 day payment plan. When building with bricks the least expensive is the super brick.

Strength and durability are usually not an issue when building with brick. Bricks have an average strength of 10,000 psi, making it suitable for building. Makalani Bricks complies with the SABS (South African Bureau of Standard) for its quality, which is 7MPa.

Building with bricks has additional costs besides building material. Sifted sand must be purchased and used as an adhesive to join the bricks. Sifted sand costs N\$79.01 per cubic meter (m³) with payment in cash and N\$143.18 per m³ with the 30 day payment plan from Makalani bricks. Additional costs also include a door and ceiling, which cannot be built out of brick.

Labor is another additional cost, and the Municipality of Okahandja would like to employ residents of the settlements for the construction process. Brick laying, for safety reasons, is usually conducted through contracting companies. According to William van Schalkwyk, the owner of Makalani Bricks, brick laying should be handled by experienced masons. Relying on unskilled labor would result in slanted walls and other amateur mistakes.

Corrugated Metal

Okahandja Wire and Steel is the local company that provides corrugated metal sheets. They have two types of corrugated metal available, Econo and Full Hard. The Econo is made from aluminum-zinc and the Full Hard is made from galvanized steel. The corrugated metal is fabricated in widths of 760mm, equivalent to 10.5 waves in the metal

(see *Figure 4.12*), and sold by the meter. At Okahandja Wire and Steel the Econo corrugated metal is sold at a price of N\$23 per meter and the Full Hard corrugated metal is sold at a price of N\$42.78 per meter. Building the structure requires three sheets of corrugated metal that are 1.45 m long and 6.5 sheets that are 1.97 m long. If the sheets used are made from Econo metal it would cost N\$391 to build the structure. Building the structure with the Full Hard metal would cost N\$733.94.



Figure 4.8: Corrugated metal from Builder's Warehouse.

The major difference between the Econo corrugated metal and the Full Hard corrugated metal is strength; galvanized steel is stronger than aluminum-zinc. The Full Hard metal is also thicker, at 0.5mm, than the Econo, which has a thickness of 0.35mm. Full Hard metal is the stronger choice but also the more expensive choice. For comparison's sake, we searched for the price of corrugated metal at Builder's Warehouse, in Katutura. Sheets of galvanized steel that were 760mm wide and 0.5mm thick were sold for N\$36.09 per meter. This is N\$7 cheaper than Okahandja Wire and Steel. Building the structure with galvanized steel sheet metal from Builder's Warehouse would cost N\$620.19.

The additional cost of a ceiling and door does not have to be taken into consideration because it can be made out of corrugated metal, though additional costs do exist. One is the bracing needed as a framework for the sheet metal. In the Okahandja Park 1 project, metal brackets were used for support. Labor in this case may be an additional cost but it is possible for the municipality to employ residents from 5Rand to build the structures. Individual owners can also build the structures if hiring labor is not a realistic option.



Figure 4.9: Image from Okahandja Park 1, showing 10.5 waves per sheet.

Concrete Structure

ROCLA, a South African company, provides concrete toilet structures. The toilets are specifically designed for high density urban areas and rural communities, such as 5Rand. The concrete structures can be built with accessories such as a removable steel door. There is also an option of having wash basins as an attachment; they can be bolted in at a later time as well. ROCLA has a regional office located in Windhoek.

In addition to the structure, shipping costs must be taken into consideration. The structure will be shipped from a prefabrication area, and the costs will be high due to the heavy weight of the completed units. There is also the potential for shock loads to damage the structure during transport. The structure must also remain in an upright position at all times.

Installation is another additional cost, due to the size and weight of the concrete unit. Installing the concrete unit (*Figure 4.13*) is technically simple but requires a great deal of labor in order to place it in the proper location. The municipality could hire the residents of 5Rand if necessary.

Sister City Results

In order to create a marketable description for the application to Sister Cities International, we toured the town to become familiar with its characteristics. We found that on the application to Sister Cities International there is only one section that requires a written description of 100 words. Of the desirable aspects of the town, we feel that the town nickname, “The Garden Town of Namibia,” as well as the large wood carving and craft centers, should be prominent in the application. Membership to Sister Cities International must be applied for online at <http://www.sister-cities.org>. The cost of membership for a town the size of Okahandja is US\$330, or roughly N\$1,980, per year.

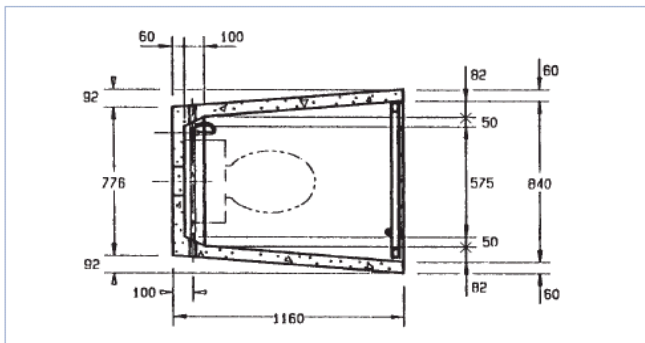
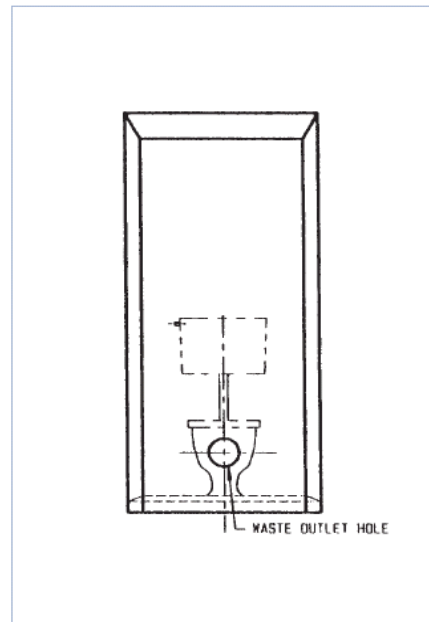
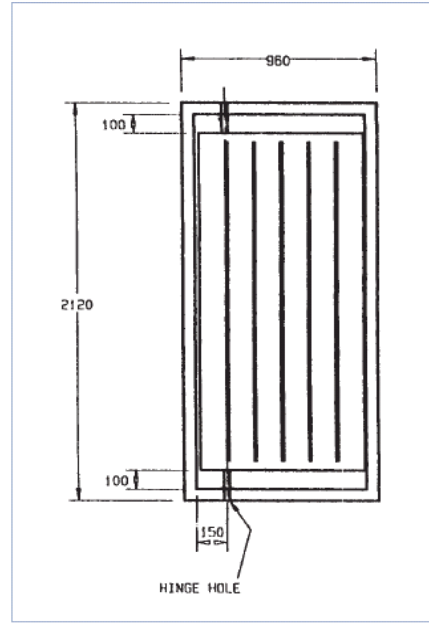
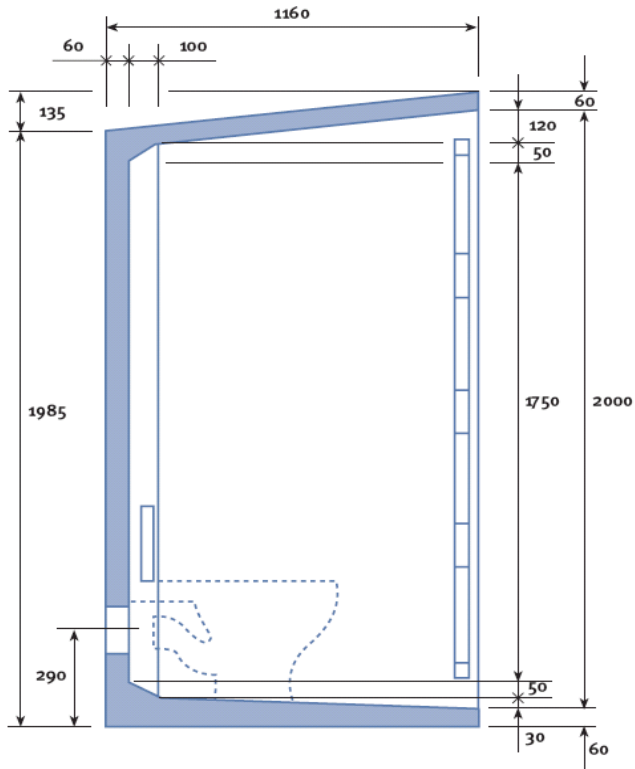


Figure 4.10: Dimensions of a ROCLA concrete unit, from <http://www.rocla.co.za>.

Chapter 5. Recommendations

The following is a list of recommendations for the Municipality of Okahandja regarding the sanitary program that will be implemented in the informal settlement of 5Rand.

- We recommend that individual toilets be implemented instead of communal toilets. Providing the residents of 5Rand with toilets on their property creates a sense of ownership that resolves many social problems, the first of which is vandalism. The toilets will not be vandalized because use is limited to one household; closer supervision by family members will be a theft deterrent. Care and maintenance also becomes less of a problem if individual toilets are implemented. With proper education the household develops conscientiousness for the facility and are able to correctly provide upkeep for the toilet.
- After researching various wet and dry toilets, we recommend that a dry toilet, more specifically the Enviro Loo, be put into place in 5Rand. A dry toilet is the better option because people will be unable to afford the water required to flush a toilet. Currently, the residents of 5Rand are spending 70% of their income on water. Because of the cost of water implementing a wet sewer system is not practical. With the dry toilets, the initial cost is higher, but money will be saved over the long term on water payments. We recommend the Enviro Loo because it is just as hygienic as flush toilets, without consuming water. It also carries many technical benefits that other brands do not.

- The Municipality of Okahandja has 25 Enviro Loos in storage, and we recommend that these Enviro Loos be installed with volunteer families on a trial basis before more are purchased. The Enviro Loos should be placed near the homes of the residents that are the most receptive to the idea of dry toilets, possibly even at the residence of a representative. To encourage use, the municipality can provide greater subsidization for the first 25 users. This method of introduction will slowly aid in dismissing the misconception present in 5Rand about dry toilets.
- Before the dry toilets are put into place for individual households, we recommend that the residents be provided with in depth-instruction on proper use. A visual-based poster showing how to use the toilet will help to prevent misuse. There should also be instructions on proper maintenance presented in a similar fashion.
- When building the structure around the toilets, we recommend that the Full Hard corrugated metal be used. It is the building material of choice due to its balance of price and strength. The galvanized steel is the second cheapest material and provides adequate strength. The economy steel, although being the most inexpensive, should not be used because it is weaker material and is sold in thinner sheets. The galvanized, corrugated metal is also locally available; it can be purchased at Okahandja Wire and Steel. It can also be purchased for less outside of Okahandja at Builder's Warehouse if using local companies becomes less of a priority.

Due to costs, the municipality might decide not to provide each household with an individual toilet, but to build communal toilets instead. Communal toilets have added concerns that require different recommendations. We would however, continue to recommend the dry toilet model the Enviro Loo in a communal setting but with more provisions.

- If the Enviro Loo is built in a communal setting, we recommend that an excess of toilets be installed. Keeping the number of people that use the Enviro Loo to a minimum, prevents overflow and reduces maintenance problems.
- An educational program becomes very important when implementing communal toilets. We recommend that education be conducted at two levels, one for the use of and one for maintaining of the facility. Educating the community on proper use of the facilities can be carried with a poster, just like individual toilets. The Municipality should hire and train community members to take care of the bathroom facilities. The training should include proper waste disposal and instructions on basic repairs.
- Safety is a social problem that must be addressed when building communal toilet facilities. We recommend that a security guard be present at each communal toilet facility to ensure the safety of users, especially women and children. The security guard must be trusted by the community, and should therefore be elected. Since women are the most susceptible to danger they should be the only voters. To reduce cost, the security guard does not have to be present 24 hours a day but only during times of high risk such as at night.

- Vandalism is another social problem that must be taken into account. We recommend using concrete structures for the communal toilets because they can withstand the vandalism. Cement can be purchased in any of the local construction companies (also at Builder's Warehouse) and is the cheaper alternative to brick.

To construct everything mentioned already into a single, concise paragraph, it is important to remember that our recommendation is based exactly on what we observed, researched, and calculated. The residents of 5Rand do not have the available income to fund having any type of flush toilet system. Though it will mean educational programs and expense related to training, a dry toilet option will improve the residents' standard of living greatly. Implementing communal facilities not only creates added hazards, such as vandalism and crime, it will require a separate educational program of its own. In order to keep the scale of the project within the means of the Okahandja Municipality, it will be important for them to only put effort into projects that have the greatest chance of succeeding. Unfortunately, communal toilet facilities, whether wet or dry, is not one of them. The greatest impact on direct savings in this project will be through the use of durable and affordable building materials. While the Okahandja Municipality has opted to spend more money to support the local economy, our recommendation will still stand, as there is a very promising local steel company.

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Appendices

Appendix A: Sponsor Information

The sponsor of our project is the town of Okahandja. Our direct contact is the acting CEO Vincent Sazita. Besides Mr. Sazita we also work closely with other members of the managerial board like Building inspector Peter Maletzky and Engineer Beren Kaurimuje. They were vital to our project because they are responsible for the infrastructure of Okahandja and more specifically the informal settlement of 5Rand.

Appendix B: Settlements and their Developmental Problems

Informal settlements are not exclusive to Africa, and neither are the resulting difficulties facing the residents. Squatters are the men, women, and children who have settled in shanties and, in the case of Okahandja, on government land. Lacking money or potential employment, the vast majority of these people now are quickly beginning to feel the negative pressure of living in a shanty town. For over half a century, there has been a worldwide need to help residents develop a community-based solution for informal settlements.

The following are examples of ways to improve the informal settlements, taken from cities that share common factors with Okahandja, Namibia. They are a resource for ideas, with their most valuable asset being that they contain results and financial evaluations from real-life models. In parts of the world where money is scarce, these cities have managed to address, confront, and deal with the problems of shanty towns. Each of these model locations provides valuable information, such as: monetary statistics, the impact of plans on the people, and the overall success of the change in housing accommodations. All of these can help the residents of Okahandja.

Appendix C: Responsible Privatization

Before the government stepped in with an effective plan, Pune, India was a city much like Okahandja. Many of its citizens inhabited the same type of informal settlements, squatting on government land and building crude shanties of their own (McLeod, 2001). Through privatization of portions of the city formerly owned by the government, Pune not only created a long-term solution, it managed to actually turn a profit and provide employment for the inhabitants.

Nongovernmental organizations (NGOs) such as the Society for the Promotion of Area Resource Centres (SPARC), the National Slum Dwellers Foundation (NSDF), and Mahila Milan (a network of slum dwelling women) were brought together to formulate a plan that could be applied not only to Pune, but to other cities throughout the country that faced nearly identical issues. The final result was a self-sufficient, self-employing, community-based plan that was able to generate revenue (McLeod, 2001). Involving inhabitants of the shanty town by consulting with them on their needs and visions created a strong relationship between the people and the government. Government support costs were kept low for the long term by involving local and international NGOs that paid the squatters for construction labor and eventually empowered individuals enough to be able to invest in land and become homeowners.

By educating several key community members about finance and management, Pune's government enabled them to pass information from person to person throughout the population. Okahandja currently has very few educational and nongovernmental organization (NGO) opportunities, especially within the informal settlements. With funds

at a minimum, the city officials could benefit from bringing in labor intensive and minimum wage businesses, while also making an effort to educate individuals about financial matters. In the long run, it will be important to improve the actual types of businesses that will employ the squatters, but in the early stages it is important to first have any type of employment opportunity. By privatizing the development of the informal settlements, the government will allow its citizens to not only learn trades and make money, but to become better prepared to own their own land. How well this works is shown by the number of contracts, 220 as of 2001, for municipal sanitation and community centers in Pune that are each able to serve approximately 1,000 people (McLeod, 2001).

Community-authority-business interaction such as this not only bridges the gaps among generations and classes, it also creates an open system of trust between formerly isolated groups. Okahandja will encounter similar situations when attempting to privatize the informal settlements. Regardless of the approach, establishing strong communication within the community will encourage cooperation.

Appendix D: Self-help and an Apolitical Plan

The success of Rio de Janeiro's Favela-Bairro (literally "slum-neighborhood") Program can be attributed to a political system that continues to hold responsibility for the program, even through the change of administrations. Rio de Janeiro created a long term plan, split it into two phases, and formed committees that made sure it would continue to progress through changes of political leadership. The Favela-Bairro idea attracted large amounts of funding by creating the Urbanization of Popular Settlements of Rio de Janeiro Program (PROAP), a self-help urban development program aimed at employing local community members like Pune, India, as labor for the construction of sanitation and municipal improvements (Brakarz, 2004). Okahandja will benefit from investing in a long term plan that is divided into smaller, more manageable parts. Combined with adequate funding and assurance of completion, an apolitical plan can prevent the lack or loss of progress.

A beneficial process that compartmentalized the areas of need involves addressing the problems of the informal settlements using a ranking system (Brakarz, 2004). In order to create a scale, a ranking system that included such factors as poverty indicators, socio-economic levels of the families, per capita income, and cost-effectiveness of potential programs was used (Brakarz, 2004). Not only did the ranking system prioritize the areas that needed to be taken care of, this public information convinced the squatters of transparency and non-partisanship. Positive publicizing helped to keep the program apolitical, making it appealing to potential supporters and contributors (Brakarz, 2004). One of the most valuable lessons learned was that public works projects should use

developed channels of communication and non-political resources to help reduce coordination and scheduling conflicts.

Although Okahandja will implement plans on a much smaller scale than Rio de Janeiro, leaders can certainly learn from the evolution of the Favela-Bairro Program. The idea of self-help creates not only employment and economic prosperity, it teaches local citizens how to manage and deal with their own problems. Prioritizing and dividing the plan of action into manageable sections is an integral part of a strategy that contains enough detail to be universally applicable to many other developing areas of the world. Specific to Okahandja, prioritization will help to realize and identify the areas in need of immediate attention. The areas that need long term attention can then also be isolated, and a separate plan can be developed for them.

Appendix E: Planning for the Future and for Expansion

Attesting to the overall success of the implementation of their master plan, Curitiba, Brazil has tripled its population to over 1.6 million in just 25 years and has only continued to prosper and expand in positive ways (WGBH, 2005). While population growth alone is not an indicator of success, Curitiba has created historical museums, central transportation systems, and employment opportunities in car manufacturing plants, all the while managing to increase the standard of living for most of its citizens (WGBH, 2005). All of this has been done without any loss in the government's systematic way of dealing with problems as they arise (Ehregren, 2004). While the international funding Curitiba receives is far greater than any amount Okahandja's inhabitants will see, Curitiba has served itself in other ways in order to keep up with the needs of its people.

By examining urban development in similarly situated cities, Curitiba's committee of urban planners organized a framework of representatives that would set a higher standard than what they saw (Whelan, 2004). Their first master plan was outlined in 1965, with main goals for projects that included controlling expansion and infrastructure, planning for future transportation needs, and the beginning of privatization and small business management (Ehregren, 2004). Okahandja city officials can easily observe the history and progression of such planning, through visiting Curitiba or seeing pictures, and from the numerous written documents dedicated to the history of the city's development.

Curitiba's transportation system, for example, is one that is envied by many other modern cities. In terms of Okahandja's needs, the actual organization of the transportation project is what is important. By interacting and listening to the needs of the people who were going to use it, the public transportation system not only met all of their needs, it only had very minimal losses (Ehregren, 2004). Overall, the city met the wishes of the people by adapting to their physical and monetary needs. Listening to and interacting with the citizens who will be using the projects results in less wasted time and money. It also serves well as a bridge between city leaders and citizens.

By researching and observing the current issues facing Okahandja, we were able to establish an informed plan of how to best pool resources, so that the project benefits all parties involved. In most cases, the people doing the work have different ideas from ones benefiting from the work. That is to say, city officials might sometimes make decisions and act on behalf of a group of people that they do not actually have contact with. By listening to what the squatters have to say, the officials of Okahandja will be able to better help them. Communication, in this simple sense, can help to prevent non-productive projects and instead lead to both involved parties feeling content with the progress.

Appendix F: Closer Connections

Though it is the capital of Namibia, with 240,000 people, Windhoek faces problems similar to those of Okahandja. After gaining independence from South Africa in the early 1990s, the people formerly forced into isolated locations by an apartheid regime found that they were able to move freely. As Gulyani (2002) describes, the result was a large influx of people into the city of Windhoek. This suddenly accelerated rate of growth, nearly 5 percent per year, caused a great increase in the size of the informal settlements. The majority of the open land surrounding Windhoek is owned by the Windhoek City Council. Approximately 30 percent of the city's population live in these informal "reception areas," as the supposedly temporary living areas are called. With the cost of land ownership far from the reach of the citizens, the city of Windhoek targeted sustainable living conditions that fell within the financial means of both the city and the people.

As of 2001, there were at least 8,000 "backyard shacks," only 3,000 of which received municipal services from Windhoek. Gulyani (2002) reports that the shanties are each on a plot measuring barely 300 square meters; communal lavatory and water facilities are unreliable at best. The main problems surrounding the issue of being legally on certain land becomes clear when the costs are examined. The purchase price of one communally serviced (water and sanitation provided) plot of land totals nearly US\$1,200 and allows for legal land ownership. Unfortunately, 50 percent of households in the informal settlements make less than US\$80 per month, and only 17 percent of the target population for which the price was set is able to legally purchase the land.

This dilemma has resulted in a change of perspective in the Windhoek city council's objectives and planning. At a minimum, the facilities had to be maintained by the local people. In order to keep costs of living down, the city of Windhoek provided the physical infrastructure, and the residents provided the means to upkeep the buildings.

Community-based programs have been introduced, and the improvements of current communities have been following a strict set of policies established in January, 2000. These policies indicate three main areas of focus: "1) Participating and co-operating to recognize, support and enhance community self-reliance, organization and partnerships; 2) Reaching beneficiaries and securing land title and housing according to affordability and standards; 3) Affirming favorable access to land and housing on a sustainable basis" (Gulyani, 2002). This extremely concise statement attests to the approach for dealing with the existing problems within the settlements. It also addresses the continued expansion of present and similar areas. Although the direct results of the aforementioned policies will not be seen for years to come, the plan is in place and each of the main elements has been broken down into specific tasks and agendas.

The future plans of the developers include expansion northwards into the Windhoek-Okahandja Valley, which already provides major road and rail transportation, connections with the coastline area, and the only main water supply in the country. It is logical to say that within only a few decades, settlements will have extended to fill the 70km strip between Windhoek and Okahandja (Gulyani, 2002). In order to deal with the sanitation, water, transportation, and land needs, both cities will not only have to work together, but will have to adapt to guidelines on how to control the expansion. Both cities can become even more poverty stricken, but with the correct planning and the correct

laws and officiating with regards to land ownership costs, it is possible to create economic stability.

The close proximity of Windhoek and Okahandja provides a unique opportunity for cooperation. If two cities are addressing the same issue, it would be more beneficial to do it together than to try and plan alone. The councils of both cities should have the ability to converse, and by opening communication links they can pursue mutual benefits such as transportation, business growth and development, and health care. The city of Okahandja is currently connected to Windhoek by a well established roadway; whether or not it will be suitable for travel in the future is an important issue. The one road is not a top priority, but collaboration can also result in the identification of tasks that require attention. Okahandja can benefit by learning from Windhoek, as they are likely to be going through similar processes of expansion within several decades.

Appendix G: Foreign Aid: Matching Needs of People

When searching for funding, the first step is to identify the need. Why is the money sought-after and what purpose will it be used for? Once the needs are clearly stated the search can begin. The goal of the search would be to match the needs of the party with the goals of the funding agency. In Okahandja, funding is required because the dwellers of the informal settlements are living in unfavorable conditions that the government wants to improve but doesn't have the means to do so. The residents are living in unhealthy environments, are unemployed and currently do not have any means of getting out.

We have roughly developed possible needs of the squatters, healthcare and unemployment. Our research establishes that there are various organizations willing to provide funding for projects that improve either need. Healthcare assistance is available from a variety of organizations. The Conservation, Food and Health Foundation's mission is to "assist in the ... production and distribution of food and the improvement and promotion of health in the developing world." There are other forms of health problems facing the settlements, one of which is HIV/AIDS. There are funds available that target this specific problem; the Children Affected by AIDS Foundation is one example. This program is designed to provide funding for projects that help children medically or socially, if they are somehow affected by AIDS.

It was mentioned earlier that the squatters have no means of relocating because they are unemployed. Unemployment has occurred because of two reasons: the first is that there are not enough jobs for the current population; the second is that the squatters

do not have education or skills that would make them qualified for employment. The Avon Foundation is dedicated to the education and empowerment of women globally. Through their Education and Economic Empowerment program Avon provides scholarships and job training for women all over the world.

Appendix H: Sources of Funding

There are three basic types of foreign aid agencies: the government-based agency, the non-profit agency, and the privately-funded agency. For our project, the government-based agency we are looking into is the United States Agency for International Development (USAID). The model for the non-profit organization will be the United Nations (UN). Lastly, the privately-funded agency we will be using as an example is the WorldBank. By searching for areas of interest and funding policies, we will obtain necessary information that could be beneficial to Okahandja.

Funding through a Government Organization

The objective of USAID is to improve conditions in developing countries while at the same time spreading democracy and promoting U.S. foreign policies. These objectives can be better explained by the history of USAID. Established in 1961 by John F. Kennedy, this agency was brought into existence as part of the Foreign Assistance Act (USAID, 2005). All of the programs through USAID must comply with the policies established by the Secretary of State.

In 2004, USAID spent 1.041 billion dollars throughout Africa alone. The manner in which the funds were distributed gives an indication as to which topics governmental agencies are interested in. Thirty percent of the money went towards HIV and AIDS relief efforts, thirteen percent went towards agricultural development, twelve percent went towards educational supplies and improvement, eight percent went toward environmental protection, and seven percent went toward conflict resolution. When considering city development tactics, the distribution of funds of the agency should be

considered. For example, if a new school were to be built, Okahandja would qualify for part of the twelve percent that USAID gives out.

Aid is distributed in two forms: acquisition and assistance. Both are beneficial for our project in Okahandja and both are available through USAID. Acquisition is “obtaining goods and services through various types of contact” (USAID). The Educational Initiative, a program developed by USAID, is an example of acquisition. In the Education Initiative the US developed programs to improve education in Africa. It included helping countries provide primary education for their citizens. There were also specific programs to educate the working class about the utilization of economic opportunities. Lastly, scholarships funds were made available to students under the Education Initiative. Assistance, on the other hand, is a form of aid that transfers funds from the aid agency to a third party that would implement programs (USAID). Grants are examples of assistance-based aid.

Funding through a Private Organization

The WorldBank, unlike USAID, is strictly an assistance-based agency. A third party organization (the city of Okahandja) would use the WorldBank to apply for various grants and loans. The implementation of the programs would be left up to the individual organizations.

Finding the “right” grant for a project requires a comparison of the grants’ objective and the project’s objective. The objectives of the grants available through WorldBank vary in the detail and specification. Some grants are for general developmental needs, while others have specific requirements. The Global Environment

Facility (GEF), a WorldBank grant, provides financial aid to organizations that are working with climate changes, biodiversity, or international water issues (WorldBank). If an organization is not working with these specific problems then it is not qualified for funding from GEF. Other WorldBank grants have broader descriptions. Organizations needing assistance can therefore tailor projects to meet the requirements of the grants. The Japan Policy and Human Resource Development Fund is a good example of a WorldBank grant with broad requirements. It provides funding to programs that reduce poverty in developing countries through the improvement of education, health, nutrition, water and sanitation (WorldBank). The diversity in grant specification allows applicants, such as the city of Okahandja, to relate their developmental needs to any one of these areas.

Funding through United Nations

Obtaining funding from the United Nations (UN) does not require applying for grants but rather for programs. This is because UN funds are acquisition-based. Acquisition-based aid is helpful for Okahandja because the UN becomes responsible for implementing the programs. Okahandja does not have the resources to take sole responsibility for all its developmental needs, so outside help might become available through United Nations Foundation (UNF) programs.

Appendix I: History of Okahandja and 5Rand

The inhabitants of Okahandja stem from two major tribes: the Herero and the Nama. The chiefs from these two tribes settled in the area around the year 1800. In 1827 a German pastor settled in the location that would later become what is modern day Okahandja. He was soon followed by missionaries from Europe. The city was officially established in 1894, upon the completion of a military base.

The name Okahandja comes from the Herero language, translating into “the place where two rivers flow into each other to form one wide on.” This name is appropriate because Okahandja is one of the few cities in central Namibia with a usable water source. In fact, NamWater is based within the city itself. NamWater is a utility company which provides water to Namibia; wood carving is another growing industry. Although it is difficult to make a living through wood carving, large parts of the population are involved in the industry and it is beginning to find a larger market in surrounding areas.

Appendix J: Bluescope Lysaght Steel

Enviro Options, a Sydney based supplier of the Enviro Loo, found that the single greatest problem it had was where to get the building structures for their toilets. The E-Hut was developed through a collaboration of Enviro Option's and Allan Howard and consulting structural engineer Craig Fyall. Their choice of steel as the main construction material hinged on the benefits of it being light weight, low cost, durable, aesthetically pleasing when painted. The Bluescope Lysaght steel company produces a Colorbond® line of steel that is non-corrosive and also offers a wide range of color choices.

The information provided by this company and its novel ideas aided our project in deciding on structural materials. Their website is helpful and descriptive as the following information can be considered a partial description of how they developed infrastructure for dry toilets in Australia.

Fyall settled on choosing the sheet steel fencing called Neetascreen® in a tan shade of Colorbond®. The cladding (ridging in the steel for strength) of the steel fencing produces ridges that would normally run vertically. By turning the sections of fencing 90 degrees, the cladding is horizontal, an aesthetic touch that gives the appearance of having a more spacious exterior and interior. The coloring is also on both sides, providing the hut with a very uniform look. The fencing material also allows the most flexibility in design, which is important, depending upon the specific dimensions that are desired. Pricing for steel structures can be done in terms of amount of individual materials, or as a price per individual structure. Freight is less than most other materials, as all of the

products needed for an E-Hut pack flat. Actual costs can be obtained by contacting the company directly:

- Enviro Options – Head Office
Unit 11, 29 Leighton Place
Hornsby, New South Wales, Australia

- Phone: 02 9456 0172
- Fax: 02 9456 0173
- Contact Person: Allan Howard
 - Email: allan@enviro-options.com.au
- Web Address: www.enviro-options.com.au



Figure 123: E-Hut construction containing Enviro Loo, specifically designed for handicapped individuals.

Appendix K: Conduit Dry Toilet (CDT)

The CDT does not use any mechanical devices in its refuse removal. Instead, it uses bins, and each CDT comes complete with bins where the waste is deposited. This is hygienic because the waste does not touch any other part of the toilet. Composting the waste can occur in two different modes: oxygen-limited mode and dehydration mode.

In the oxygen-limited mode the waste is cut off from any air supply. After the toilet is used, there is a latch that is pulled down to seal the bin. In the sealed bin nitrogen conversion to ammonia occurs. Dried shavings are added to the manure to allow it to compost, taking from 5 to 10 days depending on the weather. The ratio of shavings to manure should be 2 parts shaving to 1 part manure. The use of insecticides is recommended because of the moisture buildup that can occur. In this mode, the CDT allows for more nutrient retention in the manure.

In the dehydration mode the refuse is vented continuously until the moisture leaves the manure. The dehydration process is aided by the wood shavings, but of a less quantity than in the oxygen-limited mode. The benefit of the dehydration mode is that bins do not have to be removed as often as in the oxygen-limited mode. A disadvantage is that the manure is hard and less useful for fertilization.

Price List:

Toilet unit /with 3' of flex PVC, 120 volt plug, top back hinge straps, clamp down hardware, hook for raising toilet and wall mount for hinges.	\$ 850.00 (add \$140 for wood/epoxy top)
Flush toilet interchange vent kit /with polyurethane finish spruce stool and riser, PVC closet flange adapter and sealant.	\$ 260.00 (\$ 215.00 w/o finish)
Direct vent mounting kit with short stool.	\$ 155.00
5 gallon urine tank. Larger tanks available on request.	\$ 35.00
Additional manure bins.	\$ 22.00
Lid for manure bin - non airtight.	\$ 10.00
Great scoop for handling planer shavings.	\$ 5.00
Diatomaceous earth, 9 oz.	\$ 11.00
Organic insecticide (Rotenone/Pyrethrin concentrate), 8 oz.	\$ 16.00

Appendix L: EcoSan Dry Sanitation Toilet

In response to the growing problem of sanitation and water shortage, Eco-Sanitation (PYT) LTD has developed a dry toilet system, the EcoSan waterless toilet, in South Africa in the late 1990's. The EcoSan is designed to manage human waste through a process of dehydration and evaporation. Testing for the EcoSan began in 1997 and the product was released to the market in 2000. This waterless system is an affordable alternative to flush toilets that does not compromise health or sanitation. It has been certified by four different departments: the South African Bureau of Standards (SABS), the Council of Scientific and Industrial Research (CSIR), the Department of Health – Western Australia, and the Caribbean Environmental Health Institution.

Installation and maintenance of the EcoSan is relatively easy because there is no connection to a municipal sewer system. Without plumbing, mechanical problems are less likely to occur. Also, the EcoSan does not use any chemicals, making it safe for the environment.

How it Works:

Once refuse has been deposited into the EcoSan, it lands on a conveyor. As the lid is lifted, the conveyor rotates and moves the waste closer to the collection bag. It takes approximately 25 day for the waste to be dumped into the collection bag, which usually fills with dry waste within six months.

The human excrement becomes dry and odorless through the ventilation pipes, allowing for evaporation and dehydration. The urine is evaporated into the atmosphere

along with all the moisture from the solid waste. The solid waste can later be recycled for fertilizer and other purposes. Other objects, beside human refuse, will not clog the EcoSan if accidentally dropped in, though it is not advised to do so.

Extra products:

When purchasing an EcoSan dry toilet, there is the option of getting a Toilet Hut if the installation is outside the home. The Toilet Hut is a structure especially designed for the EcoSan. Each EcoSan also comes with a urinal that is installed within the wall of a bathroom or Toilet Hut.

Appendix M: Enviro Loo

Invented by Dr. Brian La Trobe, the Enviro Loo is an example of a dry toilet, meaning it requires no water to dispose of human waste. This specific design is the result of technological advances in the areas of water conservation and sanitation. The actual toilet is much the same as any conventional flush toilet, with the exception of the flushing mechanism. The waste is pushed by a lever down a tube into the plastic receptacle, which is buried partially in the ground outside of the facility. A non-stick surface coating the tubes ensures that the process requires no water to transport waste away from the depositor.

The tube leads from the toilet to a black plastic tank where the liquid waste travels to the bottom and the solid waste is moved onto a drying tray in the middle of the tank. As the sun beats down onto the polyethylene tank, the internal temperature rises as high as 80°C. This intense heat causes evaporation of the liquid waste and dehydration of the solid waste. 95% - 97% of the solid waste is water; therefore, the dehydrated waste has a final mass 3% - 5% of its original specimen. The remaining waste becomes a powder that is raked out of the apparatus every 6 months. The powder has no smell, as all bacteria in the waste have been killed by the high temperatures in the tank. The powder is a natural fertilizer with no added chemicals, and can be used on plants and flowers.

During the dehydration process, odors leave the toilet area through a ventilation tube that leads out of the tank and above the roof line. The tube is topped with a whirlybird, a type of turret that ensures adequate air flow out of the tank.

The total cost of the Enviro Loo varies, depending on which model is being used. The Enviro Loo 2010 is designed to accommodate 4 people for up to 3 uses per day. The cost of this model is \$2,660. The commercial model of the Enviro Loo is the 2040 which is made for use by 20 people for up to 3 uses per day. This model costs \$3,150.

Appendix N: Nature Loo

Nature Loo, a product of Australian company Sun Mar, consists of an extensive line of dry toilet options for varying degrees of use. There are three ranges entitled Compact, Classic and Ensuite, catering to individual use, medium to large family use, and upscale home use, respectively. While the Compact and Ensuite variants are not practical for Okahandja, the Classic range includes several packages that are of interest.

Developed in 1992, the Classic system is for domestic use and provides what the company claims is the least expensive composting toilet on the market. Its strengths include simplicity of design, minimal maintenance requirements, and if additional waste containers are purchased, unlimited capacity is possible. Each of the packages comes complete with everything required for the internal installation. This includes the toilet seat, pedestal, pipes and connectors. Externally, the toilet requires at least 1 meter of clearance below the floor for the waste container. For the reason that this depth is variable, the external connecting pipe between the toilet and the waste container is not provided.

The standard Classic 2 Package includes:

- Traditional white ceramic pedestal
- Oak wooden seat
- 2 composting containers (85 cm high x 80 cm diameter)
- Internal waste chute (from toilet to exterior), 70 cm in length – cut length to suit bathroom dimensions
- Ventilation system, including 12 volt, 2.8 watt fan and fan housing
- 12 volt transformer

- Ventilation cap, mesh screen cover, moisture trap for vent tube, and connecting flexible venting hose
- Installation and maintenance manual
- Price: AUD 2,360 – including all taxes

The Classic 3 Package includes all components of Classic 2 Package, plus an extra composting container for larger families.

- Price: AUD 2,660 – including all taxes

Both the Classic 2 Package and the Classic 3 Package offer exchange or purchase of certain parts in order to suit customer needs. This includes the following options:

- Pedestal: the ceramic pedestal can be exchanged for a fiberglass pedestal with a white medium density plastic (MDF) seat instead of the wooden seat
- Seat: the seat only can be exchanged for a white MDF seat
- External waste chute: extra 70 cm lengths are available for AUD 45 each
- Wind ventilator: for areas with enough breeze and lack of electricity, the wind ventilator attaches to the top of the ventilation pipe and helps to pull the odors away

Appendix O: NEC Stahl

NEC Stahl, located in Okahandja, is one of Namibia's largest steel companies. Fabrication facilities include 8,000 square meters of covered production areas. Staffed engineers are equipped to fabricate all types of steel products to the most stringent specifications.

NEC Stahl produces Econostruct, steel engineered for buildings that range from backyard sheds to schools and churches. Complete turnkey Econostruct projects are offered, and assembly is completed by their company or a separate contractor. With proper instruction, minimal skilled labor is involved and completion takes very little time. Layouts and step-by-step instructions are included for all projects.

A complete structure kit will include a steel frame, steel roof sheeting, bolts, ridge caps and sheeting screws. Sheet metal siding is offered in a variety of finishes, including brick and metal plate designs; individual finishes are also available upon request. Contact information for NEC Stahl is:

- NEC Stahl
Noord Street
PO Box 133
Okahandja, Namibia
- Telephone: +264 62 501044
- Fax: +264 62 503149
- Contact Person: Mr. AK Roux
 - Email: akroux@namencor.com.na

Appendix P: Building Material Cost Analysis Calculations

Structure Dimensions: 1.45m x 1.97m x .91m

Bricks

Block Brick

Dimension = .45m x .23m x .1m

Cash Price = N\$8.48/brick

30 day payment = N\$9.45/brick

Number of Bricks per Dimension

$1.45/.45 = 3.22 \rightarrow 4$ bricks

$1.97/.23 = 8.57 \rightarrow 9$ bricks

$.91/.45 = 2.02 \rightarrow 3$ Bricks

Total number of bricks

$2 (4 \times 9) = 72$

$2 (4 \times 3) = 24$

$(9 \times 3) = 27$

$(3+9+9) = 21$

Total = 144 Bricks

Cost

Cash: $(144 \text{ bricks} \times \text{N\$}8.48) = \text{N\$}1221$

30 Day Payment = $(144 \text{ bricks} \times \text{N\$}9.45) = \text{N\$}1361$

Super Bricks

Dimension = .22m x .10m x .10m

Cash Price = N\$1.47/brick

30 day payment = N\$1.61/brick

Number of Bricks per Dimension

$1.45/.22 = 6.59 \rightarrow 7$ bricks

$1.97/.10 = 19.7 \rightarrow 20$ bricks

$.91/.22 = 4.14 \rightarrow 5$ bricks

Total number of bricks

$2 (7 \times 20) = 280$

$2 (5 \times 7) = 70$

$(5 \times 20) = 100$

$(6 + 18 + 18) = 42$

Total = 492 Bricks

Cost

Cash: (492 bricks x N\$1.47) = **N\$723**
30 day payment: (492 bricks x N\$1.61) = **N\$792**

Standard Brick

Dimensions = .22m x .10m x .70m

Cash price = N\$1.12/ brick

30 day payment = N\$1.25/brick

**** Requires double layer**

(2 x 492) = 984 bricks

Cost

Cash: (984 bricks x N\$1.12) = **N\$1102**

30 day payment: (984 bricks x N\$1.25) = **N\$1230**

Corrugated Metal

.75m wide

Number of sheets required = 9.5 sheets

Economy

Price N\$23/m

Cost

4 (N\$23 x 1.97m) = N\$180

3(N\$23 x 1.45m) = N\$99

1.5 (N\$23 x 1.97) = N\$ 67.5

1(N\$23 x 1.97) = N\$45

Total = N\$391

Full Hard Corrugated Metal (Okahandja Wire and Steel)

Price N\$42.78/m

4 (N\$42.78 x 1.97m) = N\$337.12

3(N\$42.78x 1.45m) = N\$186.12

1.5 (N\$42.78 x 1.97) = N\$126.42

1(N\$42.78 x 1.97) = N\$84.28

Total = 734

Full Hard Corrugated Metal (Builders Warehouse)

Price N\$36.09/m

4 (N\$36.09 x 1.97m) = N\$284.36

3(N\$36.09 x 1.45m) = N\$158.1

1.5(N\$36.09 x 1.97) = N\$106.64

1(N\$36.09x 1.97) = N\$71.09

Total = N\$620

Appendix Q: Meeting Minutes and Notes

CEO of Okahandja Municipal Council, Mr. Vincent Sazita

16 March 2005 9am

Attendees:

Vincent Sazita, CEO of Okahandja Municipality
Bland Addison, IQP Advisor
Andrew Gagnon, IQP Student
Nebiat Kidane, IQP Student
Stephanie LaPointe, IQP Student

We met with our liaison Mr. Vincent Sazita in order to further define the parameters of our project. In the meeting we learned that informal settlements form because landless Namibians migrate to the city for work when employment opportunities are not great. We were also given a list of problems that face the informal settlements of Okahandja. .

- There exists 4 informal settlements in Okahandja
 - Osheti 1&2-in existence 1 year
 - Saamsteaan-in existence 1 year
 - 5Rand-in existence about 20 years
- Problems in the Okahandja informal settlements
 - Infrastructural
 - No individual water, sewage or electricity
 - Water accounts for 70% of household income
 - Housing is not permanent (corrugated metal)
 - Social
 - High crime rates, rape being the most prevalent
 - HIV is rampant
 - Alcoholism
 - Child neglect and teen delinquency

Scope of IQP

- Determine a way to solve the problems of the informal settlements as a whole or focus on one aspect.

CEO of Okahandja Municipal Council, Mr. Vincent Sazita

17 March 2005 9am

Attendees:

Vincent Sazita, CEO of Okahandja Municipality

Andrew Gagnon, IQP Student

Nebiat Kidane, IQP Student

Stephanie LaPointe, IQP Student

In this meeting we received a tour of the informal settlements of Okahandja. After the tour we met with Mr. Vincent Sazita to discuss the topic of our project.

- Confine research and model to one of the four settlements.
 - Focus on 5 Rand because there resettlement planned for Osheti 1, Osheti 2 and Saamstaan.
- Work on one infrastructural problem because the logistics of working on all problems within the time constraints is unrealistic.
 - We will address the issue of sanitation within the settlements including sewage and trash collection.

Habitat Research and Development Center, Robert --

18 March 2005

Attendees:

Robert (?), --

Nebiat Kidane, IQP Student
Stephanie LaPointe, IQP Student

We met with Robert to discuss the Enviro Loo, which is a dry toilet being used in some settlements in Windhoek. At the meeting we obtained basic information on the Enviro Loo.

- Toilet uses no water
 - A lever is pulled to deposit waste into a plastic tank
- The plastic tank is black and positioned to absorb sunlight
 - Liquid waste evaporates and the fumes leave through a tube that extends into the air.
 - Solid waste remains in container in compost form which can be used for fertilizer.
 - Enviro Loos at Habitat Research and Development Center accommodates 15 people and need to be emptied every 4 months
- Enviro Loo Toilet Cleaner can be used to clean the toilet
 - Contains no chemicals
- One unit costs \$2,000-\$4,000
- The city of Windhoek funded the toilets for the settlements.
- Further Contacts
 - Andreas-in charge of sanitation for Habitat-andreas_hrdc@yahoo.com
 - Stubenrauch Planning Consultants- the company that sells the toilets

CEO of Okahandja Municipal Council, Mr. Vincent Sazita

22 March 2005 9am

Attendees:

Vincent Sazita, CEO of Okahandja Municipality
Professor Stephen Weininger, IQP Advisor
Andrew Gagnon, IQP Student
Nebiat Kidane, IQP Student
Stephanie LaPointe, IQP Student

We met with our Liaison Mr. Vincent Sazita to propose our project idea. We decided that sanitation is the topic we would like to work with in 5Rand. We also presented Mr. Sazita with the initial research we have conducted on the Enviro Loo.

- Project overview: We will focus on sanitation infrastructure in 5Rand
- Habitat Research and Development Center
 - Toilet: Enviro Loo, dry system of human refuse disposal
 - Brick blocks made out of clay
 - Mixed with cement and pressurized to become compact.
- Necessary to setup meeting with the following people in the Okahandja Municipality
 - Engineer Beren Kaurimuje, March 29 9am
 - Representative of 5Rand March 29 11am
 - No representation in the Shack Dwellers Association
- Sanitation projects in Okahandja
 - Osheti – introduced VIP latrines
 - Were not successful, crime problems such as rape
 - Men and women latrines were semi-accepted
 - Vandalism posed as a problem
 - Potential solution, hiring toilet attendants
 - Elected attendants might ensure trust among the women of the community

Okahandja Engineer Beren Kaurimuje

29 March 2005 9am

Attendees:

Bern Kaurimuje, Engineer
Andrew Gagnon, IQP Student
Nebiat Kidane, IQP Student

We met with the Okahandja town engineering Beren Kaurimuje to discuss the current infrastructure of Okahandja and more specifically the informal settlement of 5Rand.

- Currently there are no sewage lines available in 5Rand but
 - City sewage lines exist in town
 - Blueprints will be provided by Beren
- Some electricity posts are setup in 5Rand.
 - Poles for electricity and city lights will be made available for second half
 - On a pre-paid system
- 5Rand will be setup in a grid system- starting at the end of March
 - Plots of land was divided in to even portions- looks like grid
 - Stubenrauch Planning Consultant
 - Tel. number: 061-251189
 - People will be relocated- first person arriving in land gets to stay
 - Copy of new Grid was obtained from Peter Maletzky
- Tested Enviro Loo in Osheti and 5Rand
 - Vandalized same day
 - Currently 25 Enviro Loo are in the presence of Okahandja –
 - Paid N\$7000 for one
 - Education needed to prevent misuse, responsibility need for looking after toilets and cleaning

Okahandja Building Inspector Peter Maletzky

29 March 2005 9:30am

Attendees:

Peter Maletzky, Building Inspector

Andrew Gagnon, IQP Student

Nebiat Kidane, IQP Student

We met the Okahandja building inspector Peter Maletzky to discuss sewer lines near 5Rand.

- Obtained blue prints for new grid system of 5Rand
- NamWater dams are near 5Rand
 - Usage of their sewage dams are necessary
 - Individual pre-paid meters could potentially be setup

5Rand Representatives

29 March 2005 12pm

Attendees:

10 5Rand representatives

Isaac –

Peter Maletzky, Building Inspector

Andrew Gagnon, IQP Student

Nebiat Kidane, IQP Student

We met with the representative of 5Rand to discuss the current sanitary conditions of their community. We also obtained information regarding their needs and wants.

Current sanitary conditions in 5Rand include

- Pit latrines
- Home made toilets
- Other go to the bush
- No communal toilets present

Communal toilets are not desired by representatives

- Don't like the concept and will not work in their community
 - Even with keys available someone will vandalize it
 - Will become dirty, quickly because no one will take the responsibility to clean them.
- Sharing toilet among families also is not appealing
 - Problems will arise when guests visit.
 - Water consumption disputes will occur
 - Problems with misbehaving children will occur
 - No one will take responsibility for its care.

Water based toilets highly desired over dry toilets

- More hygienic
- Dry toilets will be filled quickly
- On sunny days the odor is very bad
- Dry toilets might be favorable if there is a way to keep them clean – chemical
→ Andrew: pollutes the environment

Okahandja Company Visits

Attendees:

Andrew Gagnon, IQP Student
Nebiat Kidane, IQP Student
Stephanie LaPointe, IQP Student

Aluminiumbau Subwest

Owner: Peter Doring

We met with the owners of Aluminiumbau Subwest to discuss possible building material that are sold and possible prices. We discovered that only custom-made window and doorframes are sold.

Makalani Bricks

Owner: William Van Schalkwyk

We met with Mr. Schalkwyk to get quotes on various bricks. We received quotes for three types of bricks that differ by size; Block, Super, and Standard. We also received prices on sifted sand and stone. Mr. Schalkwyk also stated that for brick laying it is necessary to hire skilled labor.

Coetzee Drilling and Earth Moving

Owner: Bertus Coetzee

We met with Mr. Coetzee to discuss possible excavation costs. Coetzee Drilling and Earth Moving work with wells, dams, water, and sewage pipes. A quote cannot be given because many factors contribute to pricing. The area of 5Rand is more difficult to excavate because it is very rocky.

Mr. Coetzee provided us with the contact information of Namibia Plastic converters for our project.

Dan-e Van Zyl
Tel. Number: 0811282384

Okahandja Wire and Steel

Owner: J. Blaauw

We met with Mr. Blaauw to discuss pricing for metal sheets. We obtained the prices per meter for two types of corrugated metal; the Economy and the Full Hard. The Economy is cheaper but is also made of a weak material.