Improving Sanitation in Mohlaletse Village

Community based approach for the Employment-intensive construction of Sanitation facilities as part of the Mohlaletse Youth Service Programme

DWAF, 2001

Master Thesis Civil Engineering

by

Pieter van Oel

20 November 2002, University of Twente, The Netherlands

Improving Sanitation in Mohlaletse Village

Community based approach for the Employment-intensive construction of Sanitation facilities as part of the Mohlaletse Youth Service Programme

Master Thesis Civil Engineering by Pieter van Oel
20 November 2002, University of Twente, The Netherlands

This report was written mainly at the University of the Witwatersrand in Johannesburg, South Africa. This university has been a host to several students from the University of Twente for several years.

University of the Witwatersrand, Johannesburg

University of Twente
The Netherlands

The assignment, of which this report is the result, was executed to assist the Mohlaletse Youth Service Programme (MYSP) in its development activities in Mohlaletse village. MYSP emanated from the partnership of the Umsobomvu Youth Fund with Labour Intensive Training and Engineering (LITE).

A Partnership between

UMSOBOMVU YOUTH FUND

LITE
Labour Intensive Training and Engineering
Association Not For Gain

Graduation Committee:
Chairman: Prof. Dr. Ir. C.B. Vreugdenhil (University of Twente)
Members: Dr. Ir. S.J. de Boer (University of Twente),
Dr. G.D. Geldof (University of Twente)
Principal: Drs. F.L.M. Taylor Parkins (University of the Witwatersrand)

Preface

This report is the result of a research executed as the final assignment for my studies in Civil Engineering at the University of Twente in the Netherlands. The research was done mainly in Johannesburg and Mohlaletse village in South Africa, from the third of April until the twenty-sixth of July 2002. The preparation and the finishing of the report were done in the Netherlands.

Interviewing experts regarding sanitation, engineering and the circumstances in Mohlaletse village gave me valuable information. Therefore I would like to thank Richard Holden, Jacques Kruger, Mark van Ryneveld, James Croswell, Robert McCutcheon, Benjy Donaldson, Wim van Steenderen, Hubert van Zandvoort, David Llewellyn, Matjie Davis, Philemon Sekwati, Matiba Lazarus, the Mayor of the Fetakgomo Municipality, The Ward Councellor of Mohlaltese village, Paul Koopman, Richard van Oel, Rachel Sekwati, Emanuel, Nivah and the participants of the MYSP training programme.

Special thanks go out to my supervisors Cees Vreugdenhil, Sirp de Boer, Govert Geldof from the University of Twente and Filip Taylor Parkins from the University of the Witwatersrand.

Groningen, 20 November 2002

Pieter van Oel

Summary

In 2001, an estimated 18 million of 44 million South Africans did not have access to adequate sanitation facilities. Most of the seventeen thousand inhabitants of Mohlaletse village belong to this group. Besides the need for sanitation facilities, there is a need for the creation of employment in Mohlaletse village. A recent initiative to increase employment is the 'Mohlaletse Youth Service Programme.' The Umsobomvu Youth Fund (UYF) and Labour Intensive Training and Engineering (LITE) started this programme together on the 8th of April of 2002 and activities are spread over a period of 5 years. Students joining the programme are trained on the job while constructing sanitation systems in Mohlaletse village.

The research problem was formulated as follows:

What are the needs and relevant characteristics in Mohlaletse village, regarding sanitation, and what is an appropriate way for meeting the needs, using principles of community participation and employment intensive construction. How can the Mohlaletse Youth Service Programme (MYSP) assist in improving the sanitation infrastructure in Mohlaletse village?

The objective of this research was formulated as follows:

The objective of this research is to contribute to improvements in sanitation infrastructure in Mohlaletse village, by identifying criteria for the evaluation of sanitation systems, and developing a proposal for improving sanitation infrastructure in Mohlaletse village, by the Mohlaletse Youth Service Programme.

The most significant interests to be taken into account for the sanitation project to become a success are those of the households in Mohlaletse village and the trainees of MYSP. Most trainees are members of households in the village. Households are helped most with sanitation systems that improve their health, are durable and socio-culturally accepted. The trainees are concerned with future job-opportunities and their continuing education within MYSP. For the success of a sanitation project in Mohlaletse village, the most threatening conflict between stakeholders is related to the community's traditional political structure. This structure might lead to other objectives than those of the poorer people in the community.

Four different types of sanitation systems can be distinguished. These are dry on-site systems, wet on-site systems, cartage systems and sewerage systems.

Blockages of pipes of wet on-site-, cartage- and sewerage systems can occur. Unaffordability of materials or services that are necessary for proper operation and maintenance is considered to be the main cause of these blockages.

For the evaluation of alternative sanitation systems three main criteria were used. These are the needs of the households, the characteristics of the village and the relation of the project to MYSP.

The majority of households in Mohlaletse village are in need of a sanitation system with the following profile. An adequate system will avert the spread of disease among its users and the community. Its operation and maintenance requirements are affordable to the households and the system keeps operating even when not properly used. Most households do not want to share the responsibility for proper operation and maintenance.

An adequate system is not dependent on reliable water supply. A system should not contaminate water resources in Mohlaletse village, having a population density of 10-30 people per hectare and the system must operate in spite of the use of newspaper and stones for anal cleansing.

System designs should be simple enough for the constructed by MYSP students and almost all spent money should stay in the community.

An appropriate way for meeting the needs of households in Mohlaletse village can be realised by the construction of one of the five adequate sanitation systems for each participating household. These adequate alternatives are the Ventilated Improved Pit latrine (VIP), Ventilated Improved Double Pit latrine (VIDP) and the Urine Diversion toilet (UD) most households in Mohlaletse village.

For households that use toilet paper for anal cleansing and a ground water tap on their plot, two other systems are adequate as well. These systems are the Pour Flush toilet and the Aqua-privy and soak-away.

Dry on-site sanitation systems have the largest improvement potential for the village as a whole, because these systems help to increase the level of health and hygiene in Mohlaletse village faster than any of the other alternatives. They are easy to build and construction costs per facility are low. The relative low costs for operation and maintenance of dry on-site systems make them affordable for almost all households in Mohlaletse village. In addition, dry on-site sanitation systems have the smallest chance of failure, independent on the economic status of the user. This makes them more hygienic in the long term.

Community participation in decision-making and construction is the key to acceptance and effective user education. The construction of the adequate alternatives makes use of local materials and the skills of MYSP-students and local contractors possible. This stimulates the local economy and the availability of knowledge in the community.

An adequate strategy for a sanitation project in Mohlaletse village by MYSP can be formulated as follows: Households in Mohlaletse village, including a member that is being educated in MYSP, are given the opportunity to make an educated choice for a sanitation system. MYSP-students should first be trained by constructing different (adequate) sanitation systems. These physical examples / prototypes can be very useful in giving households the opportunity to make an informed choice.

There are several documents that contain standard designs for the five adequate sanitation systems. The designs can be constructed using locally ‘produced’ concrete / mud bricks, concrete parts, wooden poles and river sand. While constructing the examples / prototypes, costs of construction and materials and the amount of hours of created employment can be reported.

Wherever possible a future user of a sanitation system should be encouraged to build its own system or at least a superstructure. The most practical and possibly only solution within the framework of MYSP is to start constructing facilities at premises of households that include a MYSP student. This student should be involved in the construction of a sanitation system on the plot of his or her household. This can be of great value for the motivation of the MYSP students. In addition, the future users can be educated relatively easy on sanitation related issues through the Mohlaletse Youth Service Programme.

Samenvatting

In 2001 hadden naar schatting 18 van de 44 miljoen Zuid-Afrikanen geen toegang tot adequate sanitaire toilet- en zuiveringsvoorzieningen. Het merendeel van de zeventienduizend inwoners tellende gemeenschap van het dorp Mohlaletse behoort tot deze groep. Naast de behoefte aan sanitaire toilet- en zuiveringsvoorzieningen is er grote behoefte aan werkgelegenheid. Een recent initiatief voor het creëren van werkgelegenheid is het Mohlaletse Youth Service Programma (MYSP). Het Umsobomvu Youth Fund (UYF) en Labour Intensive Training and Engineering (LITE) hebben dit programma gezamenlijk gestart op 8 april 2002. De totale duur van de programma-activiteiten zal vijf jaar zijn. Deelnemende studenten worden 'on-the-job' getraind terwijl zij toilet- en zuiveringssystemen bouwen in Mohlaletse.

De probleemstelling van dit onderzoek luidt:
Wat zijn de behoeften in- en relevante eigenschappen van Mohlaletse, als het gaat om sanitaire toilet- en zuiveringsvoorzieningen en wat is een adequate manier om in de behoeften te voorzien, wanneer gebruik wordt gemaakt van de uitgangspunten van gemeenschapsparticipatie en arbeidsintensieve constructie. Welke rol kan het Mohlaletse Youth Service Programma (MYSP) vervullen voor het verbeteren van de sanitaire infrastructuur in Mohlaletse?

De doelstelling van dit onderzoek luidt:
De doelstelling van dit onderzoek is het bijdragen aan verberingen in de sanitaire infrastructuur in Mohlaletse, door het identificeren van criteria voor de evaluatie van toilet- en zuiveringssystemen, en het ontwikkelen van een voorstel voor de verbetering van sanitaire infrastructuur in Mohlaletse, via het MYSP.

Voor het slagen van het project is het erg belangrijk dat de belangen van de huishoudens en de MYSP-studenten worden behartigen. De meeste MYSP-studenten zijn lid van een huishouden in het dorp. De huishoudens worden het meest geholpen met betaalbare sanitaire toilet- en zuiveringssystemen die geen risico's voor de gezondheid veroorzaken en sociaal-cultureel aanvaardbaar zijn. De MYSP-studenten worden vooral geholpen met werkgelegenheid en de kwaliteit van het onderwijs dat ze genieten.

Het slagen van het project is tevens afhankelijk van de medewerking door 'stakeholders'. Het meest bedrijgende risico komt voort uit de traditionele politieke structuur in Mohlaletse. Het traditionele gezag zou wel eens andere belangen kunnen nastreven dan die van de armste mensen in Mohlaletse.

Er kunnen vier verschillende sanitaire toilet- en zuiveringssysteemgroepen worden onderscheiden. Dit zijn de 'droge on-site systemen', de 'natte on-site systemen', de 'vracht systemen' en de 'rioolsystemen'.

Het nadeel van de natte on-site-, vracht- en rioolsystemen is dat verstoppingen kunnen ontstaan. Te hoge kosten van noodzakelijke materialen voor het gebruik van de systemen en van gedegen onderhoud zijn vaak de achterliggende oorzaak van deze verstoppingen.

Voor het evalueren van de alternatieve systemen zijn drie criteria gebruikt. Dit zijn de behoeften van de huishoudens, de eigenschappen van het dorp en de belangen van het MYSP.

Het merendeel van de huishoudens in Mohlaletse heeft behoefte aan een sanitair toilet- en zuiveringssysteem met de volgende eigenschappen. Een geschikt systeem speelt geen negatieve rol bij het verspreiden van ziekten in de gemeenschap. Gebruik en onderhoud van het systeem zijn betaalbaar voor de huishoudens en het systeem functioneert ook wanneer het verkeerd wordt gebruikt. De meeste huishoudens zijn niet bereid tot het delen van de verantwoordelijkheid voor een juist gebruik en onderhoud met andere huishoudens.

Een geschikt systeem is niet afhankelijk zijn van een betrouwbare watervoorziening. Het zal de watervoorraden van Mohlaletse niet vervuilen, rekening houdende met een bevolkingsdichtheid van 10-30 personen per hectare. Een geschikt systeem mag ook niet kwetsbaar zijn voor het gebruik van kranten en stenen voor anale reiniging.

De ontwerpen van geschikte systemen dienen geschikt te zijn voor constructie door MYSP-studenten. Bovendien zou het merendeel van het geïnvesteerde vermogen in de gemeenschap moeten worden uitgegeven.

Er zijn vijf geschikte alternatieven. Drie van deze alternatieven gelden voor de armere huishoudens in Mohlaletse. Deze alternatieven zijn de 'Ventilated Improved Pit latrine' (VIP), de 'Ventilated Improved Double Pit latrine' (VIDP) en de 'Urine Diversion toilet' (UD). Voor huishoudens die zich het gebruik van toilet papier willen en kunnen veroorloven en tevens een grondwaterkraan op het erf hebben, zijn nog twee andere systemen geschikt. Dit zijn de 'Pour Flush toilet' and de 'Aqua-privy and soak-away'.

Droge on-site systemen leveren het grootse verbeteringspotentieel voor het dorp als geheel. De simpele constructie en lage constructiekosten zorgen ervoor dat veel huishoudens geholpen kunnen worden. Het gezondheidsniveau van het dorp kan hierdoor het meest kan worden bevorderd. Naast dit algemene belang, maken de betaalbaarheid en de kleine faalkansen van de droge on-site systemen hen tot de meest geschikte systemen voor vele afzonderlijk huishoudens in Mohlaletse.

Gemeenschapsparticipatie in het keuzeproces en bij de constructie is de sleutel tot acceptatie van het project en tot een effectieve gebruikersvoorlichting. The constructie van de geschikte systemen maakt het gebruik van lokale materialen en de vaardigheden van MYSP-studenten en kleine lokale ondernemers mogelijk. Dit stimuleert de lokale economie en de aanwezigheid van kennis in de gemeenschap.

Een geschikte projectstrategie voor de verbetering van sanitaire toilet- en zuiveringssystemen in Mohlaletse binnen het MYSP kan als volgt worden geformuleerd: huishoudens in Mohlaletse, met een lid dat als student deelneemt aan MYSP, wordt de mogelijkheid geboden om een geïnformeerde keuze te maken voor een sanitair toilet- en zuiveringssysteem. De MYSP-studenten worden getraind door het bouwen van de verschillende geschikte systemen. Deze voorbeelden / prototypes zijn heel nuttig voor het informeren van huishoudens voor het maken van hun keuze.

Er bestaan verschillende documenten die standaardontwerpen bevatten van de vijf geschikte systemen. Deze ontwerpen kunnen worden gebouwd met lokaal 'geproduceerde' materialen zoals betonstenen, betonnen onderdelen, houten palen en rivierzand. Tijdens de bouw van de prototypes kunnen bouw- en materiaalkosten en het aantal gecreëerde arbeidsuren per ontwerp worden bijgehouden.

Wanneer de mogelijkheid bestaat, moet de toekomstige gebruiker van een sanitaire toilet- en zuiveringsvoorziening de eigen voorziening, of tenminste het bovengrondse deel ervan bouwen. De meest praktische en waarschijnlijk ook enige mogelijkheid om dit binnen het raamwerk van het MYSP te realiseren is het starten van de bouw bij huishoudens met een lid dat als student deelneemt aan het MYSP. Deze student wordt dan betrokken bij de bouw van een systeem op de grond van zijn of haar huishouden. Dit gegeven kan van grote toegevoegde waarde voor de motivatie van de MYSP studenten zijn. Bovendien kunnen de toekomstige gebruikers gemakkelijk worden voorgelicht over gebruikersaspecten betreffende gezondheid en hygiëne in lessen van het MYSP.

Table of contents

1.

Introduction

In South Africa, sanitation and employment are two major issues that need large improvements. In Mohlaletse village[1], a rural village in the north of South Africa problems regarding these issues are acute. This report presents the results of a research that supports an attempt to improve sanitation while creating employment for young inhabitants of Mohlaletse village at the same time.

This introduction gives insight in the background of the research. The research problem, research questions and the main objective are explained as well as the research approach. In addition, the structure of the report is given.

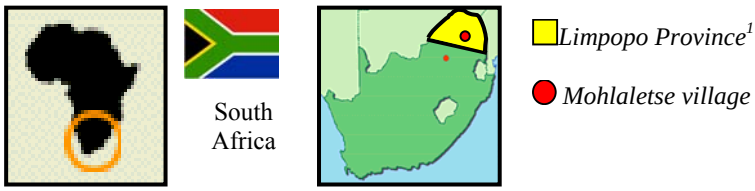


Figure 1: ***Mohlaletse village in South Africa***

1.1 Background

In paragraph 1.1.1 is described how the need for this research emerged. In paragraph 1.1.2 an introduction into the field of sanitation in South Africa is given.

1.1.1 Background of the research

For several years, there have been initiatives to increase employment in rural areas in South Africa. A recent initiative is the 'Mohlaletse Youth Service Programme (MYSP).' This programme has started the 8th of April of this year and activities will be spread over a period of 5 years and intends to train around 550 trainees. MYSP focuses on the area of Mohlaletse village. In appendix 1 a map of Mohlaletse village can be found.

Figure 2: *MYSP signboard in Mohlaletse village*

The Umsobomvu Youth Fund (UYF) and Labour Intensive Training and Engineering (LITE) initiated MYSP. The programme aims for the development of the rural community of Mohlaletse by youth development. The aim of the programme is not only to educate the youth to work in construction, but also to develop Life Skills, like dealing with contracts,

[1] Mohlaletse village is located in the Limpopo Province. Before 2002 this province was known as the Northern Province. Its capital Polokwane was called Pietersburg back then.

banking, first aid and information on HIV/Aids. Besides this, Adult Basic Education & Training (ABET) provides in courses in English language and mathematics. WORK, a research institute within the University of the Witwatersrand in Johannesburg, among others, participates in this project. One of its activities is researching problems and solutions concerning employment-intensive construction of infrastructure in Mohlaletse village.

The over-all goal of the Programme is to increase youth employment in the targeted area. The main premise of the Mohlaletse Youth Service Programme is that work will be undertaken using employment-intensive methods (Taylor Parkins, 2002). The Mohlaletse Youth Service Programme takes care of community participation in construction activities by training local people in technical and construction skills. The programme aims to give local people the opportunity to eventually start a business of their own, in the field of construction. The students educated in the MYSP will be trained on the job while constructing facilities for sanitation. Which facilities to construct in order to improve sanitation in Mohlaletse village, is the subject of this research.

1.1.2 Sanitation in South Africa

An estimated 18 million of 44 million South Africans do not have access to adequate sanitation facilities (DWAF, 2001). Households in this category generally earn less than R1000[2] a month (Mvula, 2002). Cholera and diarrhoea kill more than 50 000 South African children each year, and affect millions. People with weakened immune systems due to HIV and Aids are particularly vulnerable to sanitation-related infections and diseases (Mvula, 2002).

The policy of the national government was publicised in the so-called White Paper on Basic Household Sanitation (DWAF, 2001). The government policy focuses specifically on the provision of a basic level of household sanitation in rural communities and informal settlements. These are the areas with the greatest need. Mohlaletse village is located in one of these areas. The South African government recognises that toilets are just one element in a range of factors that make good sanitation. Community participation in decision-making, safer living environments, greater knowledge of sanitation-related health practices and improved hygiene are just some of the factors that are central to the development of good sanitation services. The South African government emphasises the importance of environmental sustainability of sanitation systems and it intends to work with people, rather than for people (Mvula Trust, 2002). More details on the government policy principles regarding sanitation can be found in appendix 4.

Figure 3: *Government slogan for its policy on sanitation (DWAF, 2001)*

1.2 Research Problem

A very important need in Mohlaletse village is employment. Around 86 % of the population that is able and willing to work has no job, and there is not much money to create jobs. Only about 5 % have a full time job (Poodt, 2001). There are people who work and live outside the village, but support the community by sending money to their families, on a regular basis. The level of education is very low, so there is a specific need for low-skilled employment.

[2] One Rand (R) equals to around 0,1 Euro

Beside the need for employment, there is a need for the improvement of sanitation facilities. Most households in Mohlaletse village make use of pit latrines, either poorly ventilated or not ventilated at all. A lot of the pit latrines, with an iron top structure, are affected by rust. Through the holes caused by the rust you can see and smell the human excreta. In the recent past kids have even fallen into these holes.

The main source of water is the river. Boreholes, spread throughout the village, are another source. Most people use the river as their primary source of water.

The contract of LITE with Umsobomvu contains the following passage:
"Water and sewer reticulation will be constructed. The quantities of each service constructed will be dependent on the output of the trainees however the target for the first year is 1500m of potable water reticulation, 1500m of small-bore sewer and approximately 50 on-site sewage digesters. There has also been budgeted for a 5000 m^3 maturation pond."(Taylor Parkins, 2002)

At the time the contract was signed not much was known about sanitation in general, the current facilities, needs of the people in Mohlaletse village and the physical appropriateness of different techniques for sanitation. The only basis for the quantification were general experience and the budget of MYSP.

Considering the aspects above, the research problem can be formulated as follows:
What are the needs and relevant characteristics in Mohlaletse village, regarding sanitation, and what is an appropriate way for meeting the needs, using principles of community participation and employment intensive construction. How can the Mohlaletse Youth Service Programme (MYSP) assist in improving the sanitation infrastructure in Mohlaletse village?

Figure 4: *common appearance of a pit latrine (two top structures over one pit is rare in the village).*

1.3 Research Questions

The physical results of a project like this have a direct influence on the life of the people in Mohlaletse village. Therefore, it is of great importance to get an insight into the socio-cultural characteristics of the members of the community in Mohlaletse village. For effective planning and implementation of the project, the political and institutional relations between the different stakeholders need to become clear as well. The answer to research question one meets the need for these insights.

For effective improvements in sanitation in Mohlaletse village it needs to become clear what alternative sanitation systems are relevant for areas like Mohlaletse village. The answer to research question two gives clearance on this point.

Before anything can be concluded about the adequateness of alternative sanitation systems, it has to be clear what aspects are important in this specific project. The needs of the households in Mohlaletse village have to be met. These needs can only be met by this project if some important characteristics of the village area are taken into account and the needs of the Mohlaletse Youth Service Programme regarding employment creation will be realised. The important aspects are called criteria and form the answer to research question three.

After answering research questions two and three it is still not clear what alternatives are adequate. Therefore, a confrontation between research question two and three is needed. The outcome of this confrontation is similar to the answer to research question four.

When knowing the strengths and weaknesses of the alternatives, compared to the opportunities and threats in Mohlaletse village, one research question still stands. That question is about MYSP and the role it could play to improve sanitation in Mohlaletse village.

The research questions are:

1. What socio-cultural and institutional aspects form the context for a sanitation project in Mohlaletse village?
2. Which alternative systems for sanitation are relevant in rural areas in South Africa?
3. What are the criteria for the adequateness of a sanitation system?
   - What are the basic needs of the people in Mohlaletse village?
   - What are the relevant physical, demographic and water supply and sanitation characteristics in Mohlaletse village?
   - What criteria derive from employment intensive construction principles?
4. What are adequate sanitation systems for Mohlaletse village, according to the criteria?
5. How can the MYSP management help to improve sanitation in Mohlaletse village?

1.4 Research Objective and Boundaries

The objective of this research was formulated as follows:
The objective of this research is to contribute to improvements in sanitation infrastructure in Mohlaletse village, by identifying criteria for the evaluation of sanitation systems, and developing a proposal for improving sanitation infrastructure in Mohlaletse village, by the Mohlaletse Youth Service Programme.

The proposal contains a general strategy for the realisation of adequate sanitation systems in Mohlaletse village. This includes an advice in respect to which stakeholders should be involved in decision-making. In addition, recommendations for the construction of sanitation systems will be given.

1.5 Research Approach

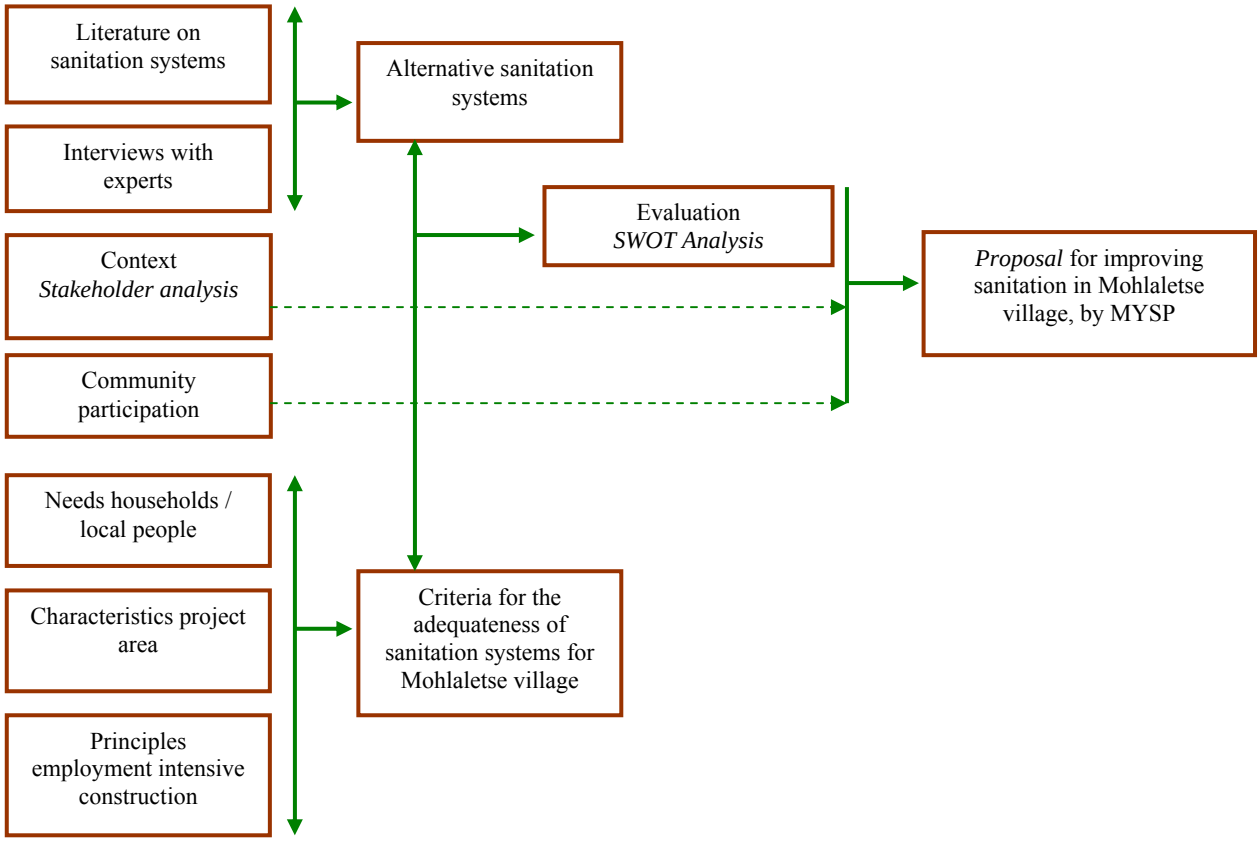


Figure 5: *Research Approach*

A study on literature and interviews with experts lead to an overview of alternative systems for sanitation, and the issues that go along with these. Information gathered on the needs of the households, characteristics of Mohlaletse village and the principles of employment intensive engineering form a framework for selection criteria. The alternative sanitation systems were confronted with these selection criteria. The results of an analysis of the needs and objectives of the stakeholders of the project and internationally acknowledged principles of community participation in sanitation projects supported the outcome of the selection process in developing a proposal for the improvement of sanitation in Mohlaletse village.

Now, it is explained how every research question was answered. Every research question is repeated followed by a description of the activities that were executed to answer the question.

1. What socio-cultural and institutional aspects form the context for a sanitation project in Mohlaletse village?

To answer the first research question mainly qualitative information was collected. This was done for orientation and iteration in the research design. In this stage, it became clear what aspects could influence the success of a sanitation project in Mohlaletse village. A relatively simple stakeholder analysis has been applied. A first visit to Mohlaletse village and surroundings was made to investigate characteristics and local needs and objectives. Experience from other development projects was obtained from documents at the University

of the Witwatersrand in Johannesburg and experts in the field of sanitation[3]. The results regarding the context can be found in chapter 3 of the report.

2. Which alternative systems for sanitation are relevant in rural areas in South Africa?

   To answer the second research question a study on literature executed. In addition, interviews with experts[2] and a visit to a provincial summit on basic household sanitation in Polokwane led to valuable information on possible techniques. Chapter 4 includes all the alternative sanitation systems that are relevant in South Africa since the national government policy on sanitation that was publicised in 2001.

3. What are the criteria for selecting a technology for sanitation?
   - What are the basic needs of the people in Mohlaletse village, regarding sanitation?
   - What are the relevant physical, demographic and water supply and sanitation characteristics in Mohlaletse village?
   - What criteria derive from employment intensive construction principles?

   The third research question was answered by doing practical research in Mohlaletse village. Interviewing and observing were the main activities. Information on the relevance of the principles of employment intensive construction was obtained from literature. At the end of this phase, the most important issues regarding the criteria were addressed. In chapter 5 the criteria are given and it is explained why they are important.

4. What are adequate sanitation systems for Mohlaletse village, according to the criteria?

   In the following phase research question four was answered. To find out which alternative techniques will lead to an appropriate way of meeting the needs in Mohlaletse village, a SWOT analysing method was used. Strengths (S) and weaknesses (W) of the different sanitation systems were confronted with the emerging Opportunities (O) and Threats (T). The Results of this SWOT analysis can be found in chapter 6.

5. How can the MYSP management help to improve sanitation in Mohlaletse village?

   Answering the fifth research question resulted in recommendations on how to operate in order to make the sanitation project successful. To develop a strategy and implementation proposal the results of the stakeholder analysis and the principles of community participation were applied. The result can be found in chapter 7.

In figure 6 the report structure is visualised. The structure represents the different parts of this report. Chapters 3, 4, 5, 6 and 7 contain the answers to the 5 research questions. Chapter 1, 2 and 8 complete the research report. The numbers in parenthesis represent the numbers of the chapters in the final report.

[3] Richard Holden from the Mvula Trust, a South African NGO in the field of water and sanitation. Mark van Ryneveld, a former researcher at the University of the Witwatersrand. James Croswell of J. Croswell and Associates, which was involved in sanitation projects before.

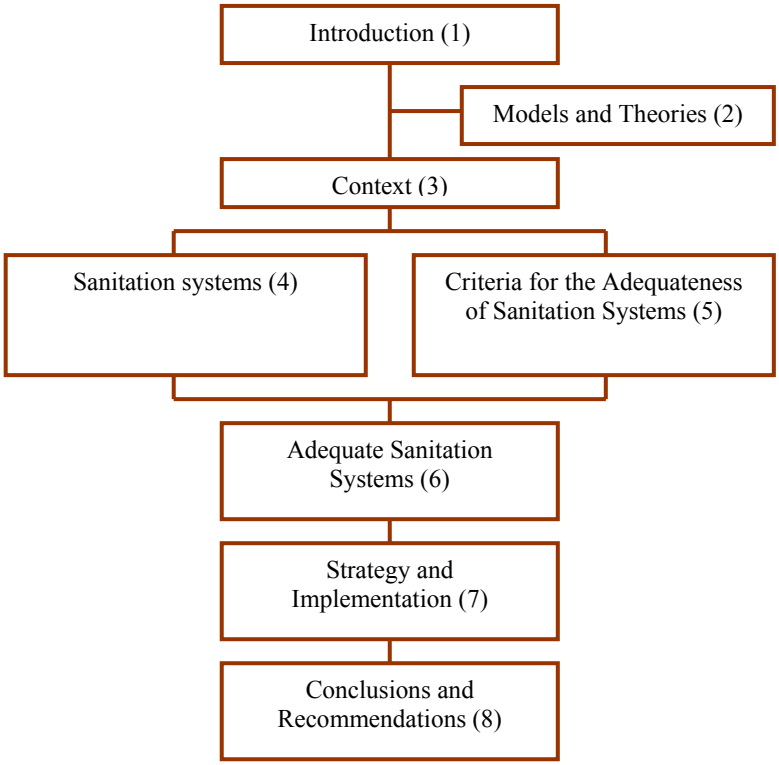


Figure 6: *report structure*

2.

Models and Theories

In this research, both sanitation aspect and employment-intensive construction aspect had to be addressed properly, both separately and in relation to each other. In this chapter the theoretical background of the research and the models that were applied are explained. Relevant theories on sanitation in developing countries, employment intensive engineering and community participation are described. The models that are used in this research are a stakeholder analysis for development projects and a SWOT analysis. These are explained in the last two sections.

2.1 Sanitation in Development Countries

On this subject, a lot of research was done in many communities in several developing countries. In his book *Low cost Sanitation,* which was published in 1995, Pickford speaks about appropriate sanitation for poor rural community members: *"Appropriate sanitation is that which meets the needs of the people in a satisfying way in relation to the resources available and other aspects of the local situation."* (Pickford, 1995)

- People's needs are primarily privacy, convenience and health
- Resources include availability of space, skills and above all finance. An agency that effectively facilitates the provision of latrines may be another resource.
- Aspects of the local situation that have to be taken into account, are climate, soil, surface and underground water, traditions, religion, culture, hygiene awareness, the proximity of other people, leadership patterns and the institutions serving the people (Pickford, 1995).

This general definition was translated into a national sanitation policy by the South African government in 2001. The White Paper on Basic Household Sanitation includes the following definition for sanitation: *"Sanitation refers to the principles and practices relating to the collection, removal or disposal of human excreta, household waste water and refuse as they impact upon people and the environment. Good sanitation includes appropriate health and hygiene awareness and behaviour, and acceptable, affordable and sustainable sanitation services."*(DWAF, 2001). Water supply is not included in sanitation.

According to the national government of South Africa the minimum acceptable basic level of sanitation is:

- Appropriate health and hygiene awareness and behaviour;
- A system for disposing of human excreta, household waste water and refuse, which is acceptable and affordable to the users, safe, hygienic and easily accessible and which does not have an unacceptable impact on the environment; and
- A toilet facility for each household

In appendix 4 the principles of the government policy on basic household sanitation can be found.

From literature and interviews with experts on sanitation (Ryneveld, Holden) two issues appear to be critical. First, there is the geological situation in a certain area. If one wants to find out whether an area is geologically suitable for on-site sanitation, one needs careful characterisation of the subsurface. Equally important is the availability and location of water resources. This information is very site-specific.

From a handbook called 'Guidelines for the provision of engineering services and amenities in residential township development', written by the South African government in 1991 during the Apartheid period, a few additional points of concern were obtained. These are:

- A system must be affordable to the recipient community for capital as well as for maintenance costs.
- Future upgrading must be considered.
- The recipient community must be involved fully in the choice for a system.
- To stimulate real involvement, the community must be trained to do the development work themselves wherever possible.
- The local authority must have the institutional structure necessary for the operation and maintenance of the system.
- A system must operate in spite of misuse by unsophisticated users and should require as little maintenance as possible.

(CSIR, 1991)

All types of sanitation systems bring along a degree of environmental impact. This impact can differ very much depending on the system that is in use.

In the case of sewerage systems, the impact is typically on the surface water body. In the case of on-site systems, the impact is largely related to groundwater quality (DWAF, 1997).

2.2 Employment Intensive Construction

In this paragraph an introduction into the theory behind employment intensive construction is given (2.2.1) and some lessons from actual employment intensive projects are discussed (2.2.2).

2.2.1 Theory

There are several different definitions on employment intensive engineering. They all focus on the use of labour force instead of equipment. Some of the definitions include a development objective. It is generally acknowledged that an employment intensive construction project should not be done to keep the employed busy. The International Labour Organisation speaks about an optimum amount of created jobs, instead of a maximum. Production should be as efficient as possible using the 'reliable' local resource 'labour' rather than a capital-intensive approach, which is prone to problems that cannot be dealt with using local resources.

Professor McCutcheon from the University of the Witwatersrand chose the following definition of employment intensive construction: "*The economically efficient employment of as great a proportion of labour as is technically feasible to produce as high a standard of construction as demanded by the specification and allowed by the funding available that results in a significant increase in the employment opportunities per unit of expenditure* (McCutcheon, 1993)*.*"

This definition takes the efficient use of as much labour as is technically feasible as a starting point. In addition, constructing must result in a civil object that fulfils the required construction quality standards. Extra employment should not decrease the quality of the

result. The limited financial resources that civil projects in developing countries usually have to cope with form a complementary restraint of this definition. Employment opportunities per unit of expenditure are a good indication for effective employment creation, but it is certainly not the only aspect that should be taken into account in a project like this.

McCutcheon's definition does not address the long-term development objective that is aimed at with the use and practical training of employees in a project, such as MYSP. The definition of Mosch that is used in the course 'Employment Based Civil Engineering' at the University of Twente in the Netherlands reads like this:

Employment Based Civil Engineering is, as far as it is technically and economically effective, making use as much as possible of the resource labour in a civil engineering project, if this results in a civil object that meets the prior to the execution of the project specified quality standards, realised without exceeding the available budget, and the use of labour contributes to the sustainable development of the region in which the project is executed (Mosch et al., 2000).

More than McCutcheon, Mosch emphasises that the quality standards should be the starting point. His definition promotes the use of the resource labour in order to meet quality standards, rather than McCutcheons definition that promotes a maximum employment creation within a budget as long as the quality standards are met.

Employment intensive projects often, but not necessarily, aim at more than the short-term creation of employment. A long-term objective of projects can be a sustainable development of technical knowledge of local people, the promotion of the use and production of local tools and the use of locally available natural resources. All these elements contribute to a more sustainable (economical) development of a region.

The Mohlaletse Youth Service Programme aims for the development of the rural community of Mohlaletse village as a whole. Youth is trained and employed to prepare them to contribute to the economical development of the village in future years. The product should be of acceptable quality and a basis on which the community can build to reach acceptable sanitation for all its members. This is why the definition of Mosch is the most suitable definition for this sanitation project.

2.2.2 Experience

Based on his experience with employment-intensive construction during the Ilinge project[4], Croswell gives some relevant recommendations:

- The design should not be physically dependent upon high standards in respect to line and level.
- Materials used and their method of installation have to be simple
- The design team has to remain closely involved with the project so that any necessary adaptation to the design can be made during the period of construction.
- (Croswell, 1986)

McCutcheon adds:

- Extensive technical and organisational analysis and research should be carried out;
- There should be a comprehensive forward planning; (McCutcheon, 1990)

Figure 7: *Employees from the community are instructed by a member of the design team (DWAF, 2001).*

[4] The town of Ilinge was created as a resettlement area for blacks in 1951. In the early eighties, a large-scale development initiative took place. Improvements in infrastructure, ranging from sanitation systems to electricity were established

2.3 Community participation

The White Paper on Basic Household Sanitation states that community participation is essential in reaching sustainable solutions for sanitation. Several experts in the field of sanitation agree with this. Here are some views:

- No technology should be chosen for a community by outsiders. Outsiders should first study what communities are currently doing, and then seek to build upon existing practices, making improvements that are affordable at each step." (Pickford 1995)
- The involvement of the community in any project is essential for its success. The extent of necessary involvement can vary in different countries. Urban communities often play a role that is quite different from that undertaken by village people. Some groups of people are homogeneous; others comprise various cultures and socio-economic levels (Frenceys, 1999).

Franceys states the importance of community participation and mentions the most important actors to be involved in the process.

- *Key leaders:* early contact should be made with key leaders, who may sometimes be identified with the assistance of the local health officials.
- *Minority groups:* whoever are selected as key leaders, care must be taken to ensure that the views of all sections of the community are represented.

Frenceys adds:

- When possible, key leaders should visit nearby completed projects to see good latrines in use. Simple drawings and models may also be used so that alternative technologies can be discussed.
- Some idea of the readiness of the community to provide labour, money and materials for a latrine-construction programme should be obtained. (Franceys, 1999)

McCommon emphasises that for effective community participation an institutional vehicle is needed. "Through such a vehicle preferences can be communicated. McCommon also stresses that communities must contribute to the development and operation of their projects if they are to feel that they own the resulting system. To the extent possible, communities should accept and exercise responsibility for operations and maintenance"(McCommon, 1990).

Summarised for this research the central idea should be as follows: No choice for a sanitation system for the people should be done, but LITE / MYSP-management should be assisted in helping individuals (households) in selecting a system that meets their individual needs in their specific situation.

2.4 Stakeholder Analysis

To identify the project's key stakeholders and to assess their interests and the ways in which these interests affect project risk and viability, a stakeholder analysis was applied. Use is made here of a stakeholder analysis of the Overseas Development Association (ODA). This analysis is specifically developed for aid projects in developing communities.

"Stakeholders are persons, groups or institutions with interests in a project or programme. Primary stakeholders are those ultimately affected, either positively or negatively. Secondary stakeholders are the intermediaries in the aid delivery process. This definition of stakeholders includes both winners and losers, and those involved or excluded from decision-making processes" (ODA, 1995).

2.4.1 Value of a Stakeholder Analysis

A stakeholder analysis helps to create an insight into the environment of a project. More specifically, doing a stakeholder analysis can:

- Draw out the interests of stakeholders in relation to the problems that the project is seeking to address.
- Identify conflicts of interests between stakeholders, which influence project's risks.
- Help to identify relations between stakeholders, which can be built upon, and may enable coalitions of project sponsorship, ownership and co-operation (ODA, 1995).

Information resulting from a stakeholder analysis is of great value for the planning and implementation of a sanitation project such as this, because quite a few stakeholders are (potentially) involved. Some of them might not be involved when not informed. Others might be involved anyway but have to participate and be properly informed, to ensure they will not have a fatal influence on the project.

2.4.2 Carry out a stakeholder analysis

There are three steps involved in carrying out a stakeholder analysis:

- Draw up a "stakeholder table";
- Do an assessment of each stakeholder's importance to the project success and their relative power/influence. In appendix 5 definitions of importance and influence are given;
- Identify risks and assumptions that will affect project design and success.

It is very important to realise that there are different levels of decision-making in the field of sanitation. On these different levels, the interests are different. On the basic level (households), a stakeholder generally prefers privacy, convenience and odour-free facilities that remove excreta and wastewater from their own property. At the next level, the neighbourhood, the households place high values on services that remove excrete from the neighbourhood as a whole. Up to the regional level or even higher, sanitation issues in the areas cannot be analysed without considering the surrounding areas. According to Seragaldin (Seragaldin, 1994), there are six distinctive levels of decision-making for sanitation. In 1994, he symbolised this in the way as shown in figure 6.

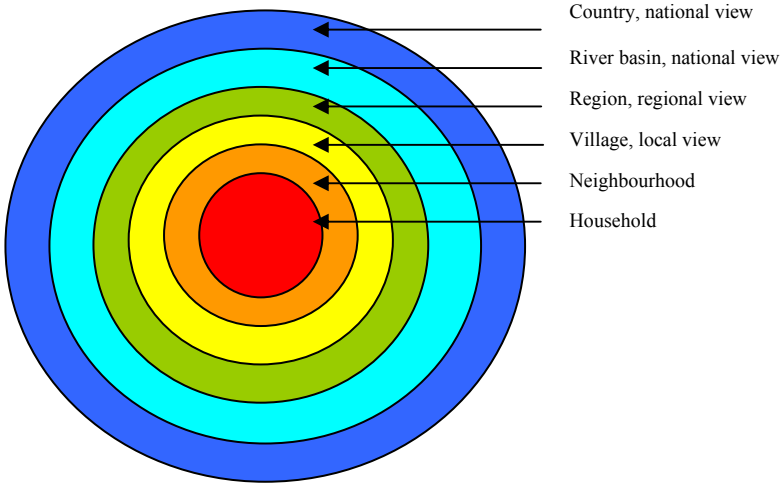


Figure 8: *the six levels of decision-making in sanitation according to Seragaldin.*

2.4.3 Stakeholder participation

Using the identified issues in the stakeholder analysis recommendations towards LITE and the management of MYSP can be done on how to treat and involve the different stakeholders.

The purpose of MYSP is to enhance the economic and social development and well being of the inhabitants of Mohlaletse village. Households should therefore be involved fully in issues regarding themselves and the society in which they live. "Effectiveness and sustainability depend practically, in part, on the commitment of stakeholders. Thus, participation is a central element in achieving aid objectives" (ODA, 1995).

Participation contributes to the chances of an aid project being effective and sustainable. It is more effective because, in drawing on a wide range of interested parties, the prospects for an appropriate project design and commitment to achieving objectives is likely to be maximised. It is more sustainable because people are more likely to be committed to carrying on the activity after the financially supported project stops, and more able to do so given that participation itself helps develop skills and confidence (ODA,1995).

From any stakeholder's perspective, participation can be considered as a spectrum model with a range of possibilities:

- Being in control and only consulting, informing or manipulating other stakeholders
- Partnership (equal powers of decision-making) with one or more of the other stakeholders
- Being consulted by other stakeholders who have more control
- Being informed by other stakeholders who have more control

(ODA, 1995).

2.5 SWOT Analysis

A SWOT analysis is used to identify and analyse the strengths (S) and weaknesses (W) of alternative techniques, as well as the opportunities (O) and threats (T) revealed by the information that was gathered on the area of Mohlaletse village.

With the results of a SWOT analysis a plan can be developed that takes into consideration many different internal and external factors, and maximises the potential of the strengths and opportunities while minimising the impact of the weaknesses and threats. Internal and external analysis in this research mean the following:

- Internal analysis: the advantages and disadvantages of an alternative are described. This was done by analysing the different technical options separately.
- External analysis: the key elements in the project environment were analysed and confronted with the alternative sanitation systems. The opportunities for the project and threats or obstacles to the performance of a system are described.

For every technical option a SWOT matrix can be made.

Strengths:	***Weaknesses:***
Opportunities	***Threats***

Table 1: *SWOT matrix*

3.

Context

This chapter is written to give the reader a first insight into some aspects of importance for a development project for the improvement of sanitation in Mohlaletse village to become successful. Special effort was made to identify the stakeholders and their interests. This chapter is the result of answering the following question.

Research question one:
What socio-cultural and institutional aspects form the context for a sanitation project in Mohlaletse village?

This context includes experience from other projects in rural communities in South Africa (3.1), a general description of the area of Mohlaletse village (3.2) and a description of the different stakeholders (potentially) involved in the project (3.3).

3.1 Experience from other projects

In neighbouring communities and other parts of South Africa, there have been several initiatives for the improvement of sanitation in recent years. In this paragraph, some lessons learnt from mostly the early nineteen-eighties Ilinge project are discussed. From Croswell, 1986 and Philips, 1992 valuable information was obtained. These lessons mainly concern community participation.

The instrument of community participation during the Ilinge project was a committee, and the level of intensity was consultation and minor decision-making. It should have been a democratically elected and properly constituted representative group. A study correctly identified the lack of participation in the choice for technology as a major shortcoming. Efforts should be made to identify and defuse potential opposition to projects at an early stage. For future development projects, they stress that the following aspects are necessary:

- A comprehensive social appraisal before a project is accepted.
- A high level of involvement of legitimate community representatives in design and implementation.

"Particularly where novel facilities are proposed, the involvement of potential consumers may be crucial in securing acceptance" (Philips et al., 1992). In Apel, a village within the Fetakgomo municipality[5], a composting toilet was constructed. The people do not want to use it. Reasons for this failure can be found in aspects ranging from practicality of use to socio-cultural aspects. In appendix 6, the reasons for the failure of this project are explained.

[5] The Fetakgomo municipality is the official governmental institute wherein Mohlaletse village is located

3.2 General description of the area

The Limpopo Province is the least developed province of South Africa. Most of its population lives in relatively isolated rural communities like Mohlaletse village. Limpopo is divided into municipalities. One of these municipalities is Fetakgomo. The Fetakgomo municipality governs the area in which Mohlaletse village is located.

The people in Mohlaletse are also under the traditional authority of the 'Acting King' K.K. Sekhukhune who rules the Sekhukhune kingdom, which reaches across several municipalities. Mohlaletse village is the hometown of the acting king and some of his closest relatives. K.K. Sekhukhune is officially Paramount Chief of the whole area covered by the kingdom. Because the current Paramount Chief is not of direct inheritance of the previous king, people call him 'acting king'. About half the population of Mohlaletse supports the 'acting king' and the other half is in favour of another son of the previous king. Tensions between the two groups in the community are a result (Davis, 2002). In appendix 2 the traditional political structure in the village is described.

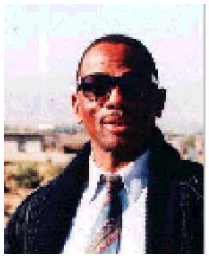


Figure 9*: Acting king K.K. Sekhukhune (H. van Zandvoort)*

Mohlaletse village counts over 17.000 villagers (Kruger, 2001) and stretches over an area of about 12 km^2. There is a river flowing through the village. This river is flowing for about eleven months a year. The soil in and around Mohlaletse village is not very fertile. Appendix 1 contains a topographical map of the village. Most of the villagers are members of the Bapedi tribe. The prominent language spoken in the area is Sepedi, a Northern-Sotho dialect. "Churches are playing a very important role in the area. Most people in the area belong to the Zionist Christian Church" (Pardeller, 1999).

The inhabitants of Sekhukhuneland are primarily women and children. There are very few economic opportunities for women and men in Mohlaletse village, as the area is remote and has little industrial and business activity. "Most of the men live and work outside the rural area. The men return every few months, but it is not uncommon for them to remain away for long periods and even to not return at all." (Pardeller, 1999).

3.3 Stakeholders

Several parties in and around Mohlaletse village are affected by a sanitation project as part of the Mohlaletse Youth Service Programme. Either by the physical results of the project or by the activities leading to these results.

"Stakeholders are persons, groups or institutions with interests in a project or programme. Primary stakeholders are those ultimately affected, either positively (beneficiaries) or negatively (for example, those involuntarily resettled). Secondary stakeholders are the intermediaries in the aid delivery process. This definition of stakeholders includes both winners and losers, and those involved or excluded from decision-making processes" (ODA, 1995).

3.3.1 The stakeholders involved

In table 2 all the stakeholders that are considered to be of any importance to the success of the project are brought together.

Primary stakeholders
► Households ► Trainees

Secondary stakeholders	
Governmental	***Private sector organisations***
► National government, Limpopo Province Government ► Fetakgomo Municipality, Marota Forum headed by K.K. Sekhukhune	► James Croswell Associates[6] ► Community based contractors
Non governmental organisations (NGO's)	***Potential stakeholders***
► Umsobomvu Youth Fund ► Joint Enrichment Project (JEP)[7] ► Project Literacy (ProLit)[7] ► Labour Intensive Training and Engineering (LITE) supported by its NetWork[8] partners	► The Churches ► Mvula trust ► Mr Donaldson

Table 2: *The stakeholders potentially involved in a sanitation project in Mohlaletse village.*

In Appendix 3 a short description of each stakeholder can be found.

The national and regional policies form a framework of rules and ideas. Because the project is limited to the area of Mohlaletse village, local government, local counsellors and traditional key leaders must play an important role. Above all, the households take in a central place in this project. For the project to be successful, households should be involved in decision-making as sanitation facilities are to be used by them, on their property.

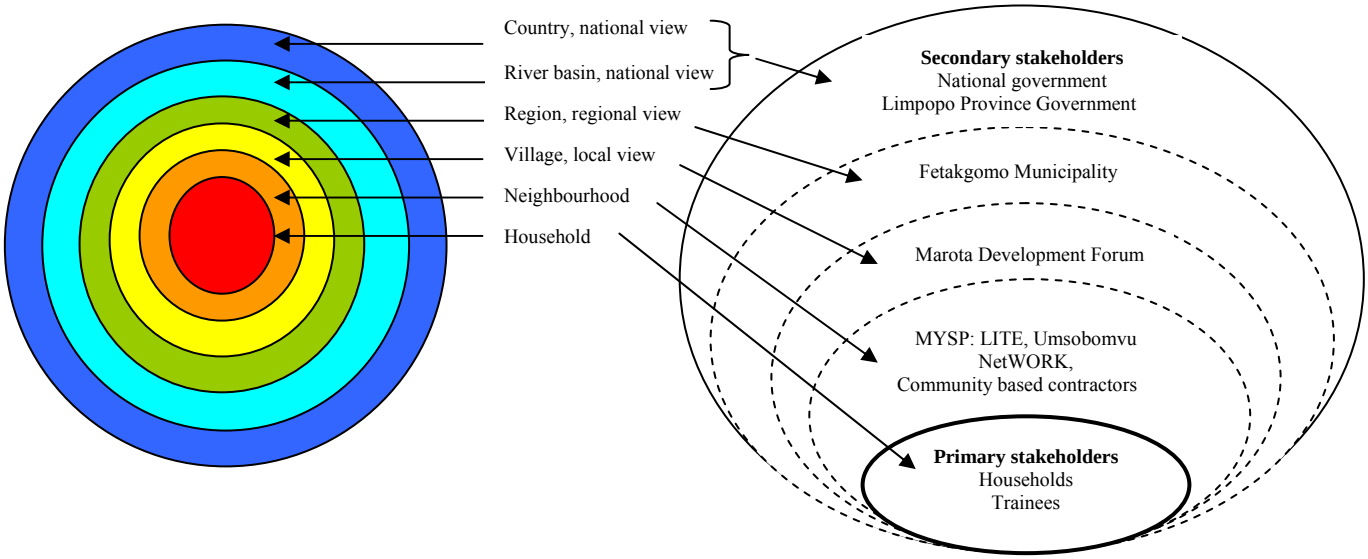


Figure 10:
a. *Levels of decision-making on sanitation* **b.** *levels of decision-making on sanitation in Mohlaletse village (Seragaldin, Worldbank 1994).*

This project is a project on village level. Therefore, an active role is expected from the following stakeholders: LITE / MYSP management Marota Development Forum, Community based contractors and the primary stakeholders. As the municipality is the lowest official governmental body, the Fetakgomo Municipality could play such a role as well.

[6] James Croswell has his own consulting company and is a member of EIEC and LITE
[7] JEP and ProLit are subcontracted by LITE for educational purposes within MYSP
[8] NetWork is a coalition formed by WORK, EIEC and LITE

The potential stakeholders will only be involved if LITE / MYSP-management makes effort to involve them.

3.3.2 Classification of stakeholders by importance and influence

According to ODA stakeholders can best be categorised into four groups, A, B, C and D. These groups are distinguished by the potential influence stakeholders in these groups have for the project and the relative importance of their needs to be pleased. In boxes A, B and C the key stakeholders of the project are written down. These stakeholders, who can significantly influence the project, are most important for the success of a project.

The stakeholders in box **A** are of high importance to the project, but have low influence. This implies that they will require special initiatives if their interests are to be protected. The stakeholders in box **B** appear to have a high degree of influence on the project, who are also of high importance for its success. This implies that there is a need to construct good working relationships with these stakeholders, to ensure an effective coalition of support for the project. Stakeholders in box **C** are stakeholders with high influence, who can therefore affect the project outcomes, but whose interests are not aimed for by the project. This implies that these stakeholders may be a source of significant risk, and they will need careful monitoring and management. Stakeholders in box **D**, with low influence on, or importance to the project objectives may require limited monitoring or evaluation, but are of low priority. They are unlikely to be the subject of project activities or management.

A: High importance, Low influence	**B: High importance, High influence**
► Households[9] ► Community based contractors[10]	► Household heads ► Trainees ► Community based contractors[10] ► LITE / MYSP management
D: Low importance, Low influence	**C: Low importance, High influence**
► Joint Enrichment Project ► Project Literacy ► Mvula Trust	► National government, Limpopo Province Government ► Fetakgomo Municipality, ► Marota / Paramount Chief of Sekhukhuneland[11] ► The Churches[11] ► Mr Donaldson ► Umsobomvu Youth Fund ► James Croswell Associates (JCA)

Table 3: *importance and influence of the stakeholders*

The 'stakeholder' LITE / MYSP management plays an essential role. LITE / MYSP management is the one that should make effort to create a situation in which the interests of the other stakeholders interests are pleased in a way that contributes most to the projects objectives.

[9] There is a difference between the head of the household (Box B) and the other members of the household, which have less influence on the project.
[10] There is a difference between the community-based contractors that already exist and the ones that might be started of as a consequence of the training programme. The ones that already exist have more influence compared to the ones that are to be helped in starting a business.
[11] The personal interests of both the leader of the church and the paramount chief are not direct targets of the project, although they probably support the project. Their influence on the attitude of the local people is quite large.

3.3.3 Stakeholder's interests

The most important interests are those of the primary stakeholders. These are the households in Mohlaletse village and the trainees of MYSP. The trainees are almost all a member of a household in the village. The most significant interests of the households are the following:

- They need a sanitation system that will not harm their health situation.
- They need a system that they can afford in the long term.
- They need a system that does not harm the environment.
- They (or at least some of them) want a facility that they think is 'acceptable to use and to see'.

The trainees of MYSP are, in addition, concerned with:

- Their future job-opportunities
- Their education within MYSP

The interests of secondary stakeholders that should be considered most are those of the Fetakgomo Municipality, the Marota Development Forum and community-based contractors. The Fetakgomo Municipality is officially responsible for all the governmental policies in Mohlaletse village, which includes the policy on sanitation and employment creation. They are able to provide subsidies. The Marota Development Forum is a local, semi-formal committee, which represents the village on several issues, including sanitation and employment creation. Community based contractors have commercial interests and are very important for the economic development of the village. The interests of the other secondary stakeholders can be found in Appendix 7.

3.3.4 Assumptions about stakeholders

'The success of the sanitation project depends partly on the validity of the assumptions made about its stakeholders. Stakeholder interactions and responses to project activities can seriously affect a project's success.' (ODA, 1995) Therefore, the most plausible assumptions about each 'key' stakeholder (group A, B, C in table 3) that are necessary, if the project is to be successful, are identified. Risks regarding the success of the project can derive from assumptions made on the interests of the stakeholders. Some examples of these assumptions accompanied by their risk are given in table 4.

Key stakeholder	Assumption	Risk
Marota Forum / Fetakgomo municipality / Paramount Chief of Sekhukhuneland, / Churches	These stakeholders support the project through all phases.	If not, problems can arise with the implementation of the project and the selection procedure
Trainees	Trainees are skilled enough to construct properly	If not, there will be no substantial improvement in sanitation
Community based contractors	They can deliver local materials that are appropriate	If not, the improvement in sanitation will not optimally support economical development
Households	Households want an 'improved' facility on *their* premises.	-There is not enough work for the trainees of MYSP -There will be no substantial improvement in sanitation

Table 4: *Examples of risks deriving from assumptions about stakeholders.*

Roughly analysed, there are not many risks expected from the different stakeholders. This does not mean that no care should be taken of the persuasion of the project and relations between stakeholders should not be dealt with very carefully. 'The top assumption in table 4 can cause most difficulties' (Holden, van Ryneveld, 2002). The Marota Forum headed by the Paramount Chief, the Fetakgomo municipality and the churches have much influence (Box C table 3), which they could use to block project activities. LITE / MYSP-management should make effort to inform and consult these stakeholders, especially the Marota forum and the Fetakgomo Municipality.

3.3.5 Risks stakeholders with conflicting interests

Some of these risks derive from conflicting interests. In general, risks will be evident from those stakeholders in box C (table 3), which have high influence, but have interests that are not in line with project objectives. The stakeholders' conflicting interests can lead to inconveniences or even lead to a block of the project. 'Risks like these are even more threatening than the ones from the previous paragraph' (Holden, van Ryneveld, 2002). The risks are drawn down in table 4. The second and the fourth column show the two stakeholders involved in the conflict. The third and the fifth column show their conflicting interests.

Conflict	Stakeholder 1	Interest stakeholder 1	Stakeholder 2	Conflicting interest
1	Poor households	Basic sanitation	Marota Forum, Paramount Chief of Sekhukhuneland The Alliance Church	Priorities location / certain (richer) households
2	Not so poor households	Status	Community based contractors	Use of local materials
3	Households	Affordability	Community based contractors.	Most profit comes from expensive designs
4	Households	Affordability	Community based contractors Umsobomvu Trainees	Employment creation (on long term / maintenance)

Table 5: *Assumptions about stakeholders leading to risks.*

The first potential conflict is related to the communities' traditional political structure (appendix 2) that sometimes has other objectives than the government and NGO's. The former can prefer to favour well-respected members of the community, whereas the government and NGO's tend to help the poorest of the poor. The poorest of the poor in Mohlaletse village are not the most respected members in the community. This potential conflict can be very threatening to the success of a project like this. "Experience has shown that providing only a few households in a village with a proper facility has limited impact. Deciding which households benefit from limited funding support can prompt tensions, which undermine the project as a whole" (Mvula, 2002).

Community based contractors, using locally available materials, can play an important role in the economically sustainable development of Mohlaletse village. Households in that community might prefer materials from outside the community, because they like to have things that give them an 'above average' status within the community.

Most households within Mohlaletse village do not have the financial power to pay for maintenance (undo blockages) and proper operation (toilet paper, water) of certain facilities,

like water borne sanitation systems. A commercial company might prefer to design facilities of which they can get the largest revenues.

A fourth potential conflict lies within the 'double-objective' character of the project. Appropriate sanitation for the households in Mohlaletse village does not naturally mean that employment creation is at a level that the Umsobomvu Youth Fund, LITE and the trainees of MYSP would like the most.

3.4 Conclusion Context

Experience from other projects showed that community participation in identification, planning and implementation is essential, especially when new technologies are introduced.

The most important stakeholders for this project are the households in Mohlaletse village and the MYSP trainees, which could be seen as only one stakeholder, if only the households that include a MYSP trainee are analysed.

The traditional political structure in Mohlaletse village can cause tensions between different groups of people.

4.

Sanitation Systems

Travelling around the world one is confronted with many different ways in which one is to get rid of his or her faecal waste. Different cultures and ever improving technical knowledge lead to a wide variety in sanitation systems. But what sanitation systems are best for Mohlaletse village? A first step in answering this question was made by gathering information about sanitation systems. In this chapter, answers to the second research question are expressed.

Research question two:
Which sanitation systems are relevant for rural areas in South Africa?

In addition, the relation between water supply and sanitation systems is discussed in paragraph 4.3, because the one should never be considered while ignoring the possible effects for the other.

4.1 Sanitation systems in developing countries

Roughly analysed there are four different groups of sanitation systems in developing countries (Loetscher, 1999, Hanæus, 1997, Kalbermatten, 1982). These are:

- **Dry on-site systems:** No water is needed for operation and digestion or collection of waste is dealt with on the premises of the user or owner.
- **Wet on site-systems:** Water is needed for proper operation and digestion of waste is dealt with on the premises of the user or owner.
- **Cartage systems:** Water is needed for proper operation and waste is collected to be transported to a central treatment facility.
- **Sewerage systems:** Water is needed to keep a network of connected facilities operating. The network leads to a central treatment facility

Every different group represents several systems. In Appendix 8 systems that are widely used in developing countries are dealt with. For every system the principles of operation are described in appendix 9.

Of course not everybody in developing countries owns a sanitation system. If they do, for instance after being provided with a facility through an aid project, this is no guaranty for proper operation. Bad construction methods, misuse and lack of money for proper operation can be causes of health-related problems.

4.2 Sanitation systems in South Africa

The White Paper on Basic Household Sanitation (DWAF, 2001) the South African national government identifies four sanitation systems that are not recommended for future use within the borders of South Africa:

- **Simple pit latrines / Unimproved pit toilets:** These pits produce bad smells and are subject to fly nuisance and can easily become a source of disease.
- **Chemical toilets:** The government argues that they are too expensive and temporary.
- **Bucket toilet:** The South African argues that bucket toilets (cartage) are unhygienic and environmentally undesirable.
- **Communal toilets:** Whatever the technique is, it should not be shared by more than one household. Communal toilets are considered unhygienic.

As the researcher agrees with the South African government on this policy, these options are left out of the research. The techniques included in the research are all approved by the South African national government and can be found in table 6.

Dry on-site systems	*Wet on-site systems*
► Ventilated Improved Pit latrine (VIP) ► Ventilated Improved Double Pit latrine (VIDP) ► Urine Diversion toilet (UD)	► Pour-Flush latrine ► Aqua-Privy and Soak-away ► Septic Tank and Soak-away
Cartage (off-site treatment)	***Sewerage (off-site treatment)***
► Pour-Flush Toilet with Conservancy tank	► Full Bore Waterborne Sewerage ► Shallow sewerage ► Small Bore solid free sewerage

Table 6: *Sanitation systems in South Africa.*

In the following paragraphs, different sanitation systems are described briefly and some experiences with these systems in South Africa are discussed. For each system, the principles of operation can be found in appendix 9.

4.2.1 Dry on-site systems

Dry on-site systems for sanitation are, when properly designed, constructed and used, very hygienic facilities. They are odourless and do not cause harm to peoples' health.

Ventilated Improved Pit latrine (VIP)
The VIP involves a top-structure over a pit. A pipe over which a fly-screen is placed ventilates the pit. The pit may be lined (recommended where emptying is required), or unlined where soil conditions allow this.

The VIP is widely used internationally and in rural and semi-urban areas of South Africa. It is most successful in water-scarce environments. Failures are generally due to inadequate user education and/or poor design and construction. Costly adaptations can result where shallow rock or shallow water tables occur. (DWAF, 2001)

Figure 11: *Ventilated Improved Pit latrine (VIP) (DWAF, 2001)*

Ventilated Improved Double Pit (VIDP) toilet
A VIDP consists of a single top-structure over two shallow pits, side by side. Only one pit (vented by a pipe protected with a fly screen) is in use at any time. VIDPs are generally lined and the central wall should be fully sealed to ensure isolation of one pit from the other. When one of the pits is emptied a few months after the owner stopped using it, its content can be used as compost.

Resistance to the handling of decomposed waste and timely changeover of pits by householders has often been overcome through education. This VIP alternative is often

applicable where rocky or groundwater conditions prohibit deep excavation. A problem that can occur in these areas is that the liquids cannot infiltrate the soil. (DWAF, 2001)

Composting/urine diversion (UD) toilet

The UD has a single top-structure over a sealed container, which could be one of two chambers side by side (as for the VIDP), with access for the removal of decomposed waste. Urine can be lead to a small soak-away system. A vent pipe may be installed to encourage drying of the waste. Waste can be reused or burned several times a year.

The moistness of the content is vital for proper operation. Contents often become too wet, making the vault difficult and unhygienic to empty, as well as malodorous. UD systems are still being monitored in South Africa but appear to be accepted by certain communities and working without significant problems. Burning of the compost prior to the removal is also tested in South Africa. User education is required and continuous input is significant for proper operation in terms of the composting process. (DWAF, 2001)

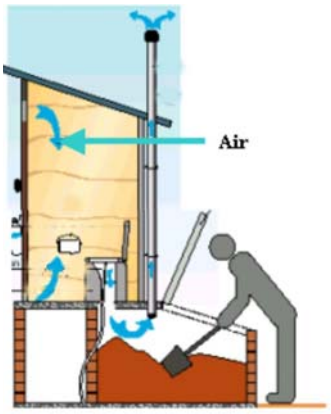


Figure 12: *Compost / Urine Diversion toilet (UD). (DWAF, 2001)*

4.2.2 Wet on-site systems

Pour-flush toilet

The pour-flush toilet is a toilet with a water-seal arrangement. This is a pan trap fitted into the floor slab, and optionally discharging through a short stretch of pipe or channel. 2-4 litres should be poured in every time the toilet is used.

The pour flush-toilet is internationally accepted where water is used for anal cleansing and users squat. Blockages occur through use of inappropriate anal cleansing material. A pour-flush toilet can be placed inside the house, but then generally larger flushing volumes are required. Experience in South Africa showed failures through lack of user education, poor design and construction and limited provision of affordable emptying service. (DWAF, 2001)

Aqua-privy and Soak-away

This facility includes a toilet with a 'rough' water-seal arrangement. This can be a straight or curved chute running from the seat to below the water level where the waste is collected and led to a soak-away. No water is needed for flushing, but the level of liquid in the tank must be maintained.

This system has been used successfully where water is used for anal cleansing and users squat. Blockages occur through use of inappropriate anal cleansing material. Bad user education, poor designs and limited provision of affordable emptying service were reasons for failure.

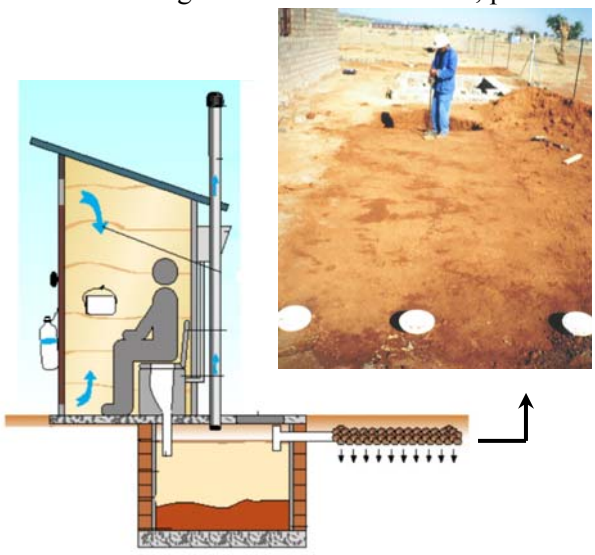


Figure 13: *Aqua privy and soak-away and a soak-away under construction in Mohlaletse village (DWAF, 2001)*

Septic tank and Soak-away

This facility includes an in-house full flush-toilet connected via pipe and plumbing fixtures to an underground watertight settling chamber (digester) with an effluent outlet to a subsoil drainage/soak-away system.

This facility is widely used by formal rural households, where reliable water supply is available. The system provides a high level of service and user convenience. Failures can occur due to poor design and construction, and due to the use of inappropriate anal cleansing material. A soak-away system is particularly prone to failure in the long-term if detailed soil testing is not carried out. (DWAF, 2001)

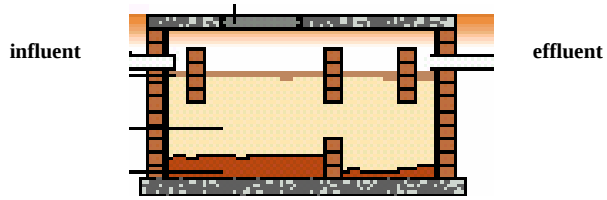


Figure 14: *septic tank (DWAF, 2001)*

4.2.3 Cartage systems

Conservancy tank

The conservancy tank is a storage system. The storage tank is sealed and isolated from its surrounding soil. A low-flow or full-flush toilet system is used. This facility is widely used, particularly in more densely populated, sensitive soil and geo-hydrological environments. (DWAF, 2001)

4.2.4 Sewerage systems

Full bore waterborne sewerage

An in-house full-flush toilet connected to a sewer network that drains to a wastewater treatment facility.

Full bore waterborne sewerage is widely used and is generally the aspiration of all South Africans although unaffordable to many, particularly in terms of access to sufficient volumes of household water. Appropriate anal cleansing material is required. The health consequences of failure are devastating in comparison to on-site, dry sanitation. (DWAF, 2001)

Small bore solid-free sewer

This facility includes an in-house toilet discharging to a septic tank (digester) with effluent disposal via a small diameter sewer to a central collection point or existing sewer system.

Not widely used in South Africa, except where existing septic tank and soak-away systems have been converted for convenience and / or environmental reasons. Failures can occur as for septic tanks above, and due to lack of maintenance of the pipe network. (DWAF, 2001)

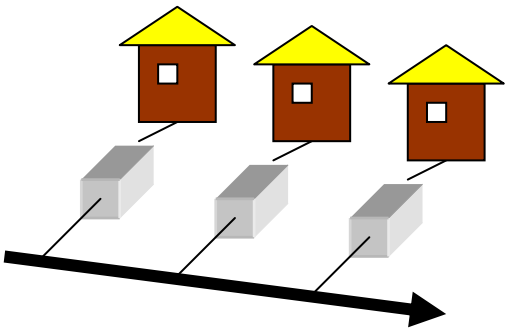


Figure 15: *Small bore solid free sewer*

Shallow sewerage
A toilet, usually in-house, flushed using lower volumes of water than either conventional sewerage or septic tanks, to smaller diameter sewers laid at flatter gradients and shallower depths between dwellings on a block. On-site shallow inspection chambers are provided.

Shallow sewerage systems have not been used widely in South Africa. They are used, with reported success, under a wide range of conditions in a number of South American countries, Ghana, Pakistan and Greece. Pilot projects have been completed in Durban and Free State, with ongoing monitoring to determine overall success and sustainability. These indicate savings of up to 50% over conventional sewerage capital. (DWAF, 2001)

Differences between alternative pans for flushing can be found in Appendix 9.

4.3 Relationships water supply and Sanitation

Clean water is a basic need for all people. When people do not have tap water that originates from a source outside their area, they depend on the quality of the water within their own area. This water usually is obtained from a river or out of the ground. Sanitation facilities can be a source of pollution to these valuable water resources. In case of off-site treatment sanitation systems pollution of rivers and lakes is most common. On-site systems can be a threat to the groundwater quality under unfavourable conditions when biological digestion is not completed when the waste reaches clean water sources. Polluted water resources that are used for drinking can cause diseases and epidemics of for instance diarrhoea and cholera among the population depending on a polluted water source. In Mohlaletse village no complaints about ground water pollution were reported, but no specific information about the ground water quality was found.

Another relation between water supply and sanitation is the quantity of water people use. When more water is available people can start using it for other purposes than before. Renewed sanitation systems for example. Extra water supply into a community can lead to a considerable increase of wastewater into the ground or surface water body. In a community like the one in Mohlaletse village, where water is scarce at this present moment, additional water supplies could cause increased water use for sanitation. The national Department of Water Affairs and Forestry states: ‘The risk of nitrogen or bacteria reaching the groundwater is increased if household wastewater is disposed into a latrine or soak-away’ (DWAF, 1997).

The Mvula Trust, a South African NGO in the field of water supply and sanitation warns for the realisation of waterborne sanitation facilities: "It is the mixing of faeces with grey water that causes most of the pollution problems" (Mvula, 2002). If a part of the population gets access to more clean water, this can lead to polluted water for others who cannot afford the new luxury.

4.4 Conclusions Sanitation Systems

Dry on-site and wet on-site sanitation systems are most relevant for poor rural areas like Mohlaletse village. Because cartage- and sewerage systems have been applied with success in the past (Croswell, 2002), these systems are considered as relevant at this stage as well.

Sanitation systems can be a source of pollution to valuable water resources. Additional water supplies could cause an increased water use for sanitation. When waterborne sanitation systems are introduced, pollution of valuable water resources can increase.

5.

Criteria for the adequateness of sanitation systems

The needs of the households in Mohlaletse village can only be met by sanitation systems if local circumstances are favourable for their operation. In addition, adequate training of the Mohlaletse Youth Service Programme should be possible during the construction of sanitation systems. Therefore, research question three was answered.

Research question three:
What are the criteria for the adequateness of a sanitation system?
- What are the basic needs of the people in Mohlaletse village?
- What are the relevant physical, demographic and water supply and sanitation characteristics in Mohlaletse village?
- What criteria derive from employment intensive construction principles?

This chapter is subject to the aspects that determine the adequateness of the alternative systems. The strengths and weaknesses of the different techniques for sanitation are relative to the needs of the households, characteristics of the area and principles of employment intensive engineering

Using knowledge gathered from various documents and interviews with experts three basic criteria for the selection between alternative sanitation systems were formulated. These basic criteria are divided into sub-criteria. These criteria are brought together in table 7.

Needs households	Characteristics Mohlaletse village	Employment intensive principles
► Health and hygiene ► Durability ► Socio cultural needs	► Physical conditions ► Population characteristics ► Water and sanitation	► Simplicity of construction ► Employment creation per unit of expenditure

Table 7: *Criteria for the selection of sanitation systems*

5.1 Needs of the people in Mohlaletse village

The households in Mohlaletse are the stakeholders to be served with the construction of sanitation systems. The needs of the people in Mohlaletse village regarding sanitation are divided into three sub needs (Holden, van Ryneveld, Croswell, Sekwati, 2002). These are health and hygiene; durable solutions; and socio cultural needs. The health and hygiene situation can only be improved properly if the constructed systems are durable. In addition, it is essential that a sanitation system is socio culturally acceptable for the inhabitants of Mohlaletse village.

5.1.1 Health and Hygiene

As far as it is known among the community, the health status of the people in Mohlaletse village is one of a typical rural South African community, which means that quite a few members in the community are confronted with HIV/Aids, cholera and diarrhoea.

According to government standards (DWAF, 2001), over 68 % of the surveyed households[12] need an improvement to healthier sanitation. Almost all people complain about hygiene, indicated by smell and insects. Constructing healthier and more hygienic systems is not the only solution. The proper use of even the simplest facilities should not be taken for granted. Not all people can afford (money-wise and time-wise) the necessities for proper operation and maintenance. These necessities include the use of water and proper materials for anal cleansing. It is therefore obvious that people are only helped regarding their health and hygiene if they have facilities that are affordable. Besides, many people just do not know what acts and situations lead to unhealthy situations. This means that there is a need for education as well.

5.1.2 Durable solutions

For a sanitation system to be durable it should be economically sustainable, have a large self help potential, should be robust and does not create the need for intensive actions for operation and maintenance.
Only if proper operation and maintenance are affordable, sanitation systems are economically sustainable. In 2001, Poodt did a research on the socio-economic situation in Mohlaletse. The most important results were:

- Around 86 % of the potential economically active population has no job.
- The amount of money households can spend every month varies from R0 to R1621.50. The average is **R729.40** per month. This equals about **73 Euros** a month, to be spent by households with an average of seven members.

In general, people spent (all) their income on: food, energy, clothing, water, shelter, sanitation, school fees, transport and healthcare (Holden, 2002). A conclusion is justified that many households do not have extra money to spend on the construction and maintenance of improved facilities for sanitation. Therefore, facilities should involve costs that are as low as possible. Especially when operation and maintenance is concerned.

Figure 16: *Unused urinary in the church. A stone was put in to emphasise it should not be used. By using a pit latrine, scarce water can be saved (Sekwati, 2002)*

It is widely recognised, that households should be able to execute reparations when sanitation systems fail. Especially when households cannot afford repairs by outsiders. This means that sanitation systems preferably should be as simple as possible. Equally important for the self-help potential is the responsibility for repairs. If the responsibility cannot be addressed, for example with communal systems (network systems), fixing can be delayed seriously, causing unhealthy situations.

Even when a sanitation system is not properly used, the facility should still be operational in a way that does not cause an unhealthy situation, or formulated in a different way: the system has to be robust.

[12] The results of this questionnaire among 59 households are described in appendix 14.

Need for frequent operation and / or maintenance activities should be avoided. Some sanitation systems require a certain effort to make them operate properly. An example is the urinary in a church in Mohlaletse village (figure 16). After every use, flushing water should be poured in. The urinary is in use because to collect water, one must walk about 50 meters. Besides, some people say, there is no need for using the urinary, when a latrine is nearby already. This system is an unneeded luxury that needs scarce water for its operation where other systems do not (Holden, Sekwati).

5.1.3 Socio cultural needs

A questionnaire (appendix 13) made clear that the majority of the households are unhappy with their facility for sanitation. Some people feel bad because they do not even have a facility, or because they have to use stones for anal cleansing. Sharing of facilities with other households is disapproved by more than 80 percent of the households. They do not want to share responsibility for cleaning and costs for operation and maintenance. Even when sharing means that more convenient facilities become possible most community members do not embrace the idea of sharing.

Hygiene education is practically non-existent in Mohlaletse village. Most people know about diseases, but do not act accordingly wise. Washing hands after using the toilet is rare. Some sanitation systems are unknown to most members in the community. Rejection of such systems can be the effect, when people do not know how to operate them properly. In Appendix 6 an example of the rejection of a composting toilet is given. Over two thirds of the surveyed households have knowledge about the reuse of nutrients from human waste. Some of them would like to use a sanitation system that would make that possible.

Figure 17: *UD toilets in Apel are not used. Main reasons: Old people get tired using stairs, communal use and responsibility for maintenance was not properly addressed. Right: door for emptying toilet.*

5.2 Characteristics of Mohlaletse village and its community

In this paragraph the physical conditions, essential demographic characteristics and the current situation regarding water and sanitation are described. Obviously, physical conditions are important in respect to the possible application of alternative sanitation systems. The demographic characteristics are important because the population is the entity that is to be served. The current situation regarding water and sanitation is of great importance as this indicates the starting point and shows what is working and what not. Furthermore, it gives an indication of what is accepted and what can be afforded among the community.

The main characteristics, critical for the selection and design of sanitation systems in Mohlaletse village were selected using Kalbermatten (Kalbermatten et al., 1982) and Loetscher[13] (Loetscher, 1999).

[13] Loetscher did a survey amongst sanitation projects in several, mostly Asian countries. The criteria / characteristics, which he found to be most important for the selection of systems for sanitation are included in the description of environmental influences.

5.2.1 Physical Conditions

The maximum temperatures in Mohlaletse village range from an average maximum of 20 ^{0}C in the dry winter season and 27 ^{0}C in the wet summer season. There are also periods of extreme heat with temperatures over 40 ^{0}C. Partly because of these high temperatures, epidemics are not rare in Mohlaletse village. Rainfall is concentrated in summer and has reached amounts of 500 mm per annum over the last five years (Llewellyn, 2002). Rainwater is a scarce resource, which quite a few households attempt to collect. They mainly use it for drinking and washing. The scarce but heavy rains can cause severe damage to infrastructure. It is fair to say that the scarcity of water cannot be neglected in selecting sanitation systems.

Slopes in the residential area vary from 1 to 5 per cent. Details of the topography of Mohlaletse village can be found on a map of Mohlaletse village in Appendix 1.

The soils in Sekhukhuneland are generally sandy and sandy loam and soil fertility is low (Pardeller, 1999, Shabalala, 1999). Close to the river the soil consists of a mixture of sand and clay. Near the mountains the topsoil is a few meters at highest and contains many large boulders. Below the topsoil, solid rock is found. Of the sanitation systems that are in use at this moment in Mohlaletse village, no permeability or pollution related problems have been reported or noticed in recent years (Shabalala, 1999). Therefore, it is fair to say that the soils are adequate for the use of on-site sanitation systems.

For groundwater pollution, the thickness of the unsaturated soil is of similar importance as the permeability of soils (DWAF 1997). This thickness may vary over the year. The yearly minimum is of course the most important. Based on an aquifer classification map (DWAF, 1997) it became clear that Mohlaletse village is not located on top of a major aquifer. In all sub areas[14] of Mohlaletse village the maximum ground water table is only found below 15 meters underground. This was found out by measuring the depth of wells[15]. The groundwater is most likely not under the influence of pollution by dry on-site sanitation systems (Appendix 10).

Figure 18: *Mohlaletse village is surrounded by large dry areas.*

Conclusions of the use of the DWAF protocol:

- Pits should not penetrate into the groundwater table. The thickness of the unsaturated zone is large enough.
- Occasional rises of the groundwater table are of no significance.
- Especially for dry on-site sanitation systems, no contamination of the ground water in Mohlaletse village is expected.
- Wet on-site sanitation systems will most probably not pollute the groundwater as well, but knowledge on this is not available. If on-site wet systems are applied, testing should be organised first.

[14] The seven largest sections of Mohlaletse can be found on the map in appendix 1

[15] In 1996, a development organisation named Operation Hunger constructed 43 boreholes and pumps in Mohlaletse village, to support agricultural through irrigation. By 2001 28 of the boreholes were still in use, mainly for drinking water. Locations of the boreholes can be found in appendix 1 (Willems, 2001).

5.2.2 Demographic characteristics

According to a population count in 2002[16] the population in Mohlaletse village is 17.325. The growth rate is about 0.5 percent each year, but developments like urbanisation and increasing death rates caused by HIV/AIDS can influence this rate drastically. People are not evenly spread over the village and there is a difference in population growth between the 'old Mohlaletse' and its 'extensions'[17] in recent years. The average population density is around 14 people per hectare (including open spots). In the older concentrations this is around 30. In the extensions about 3 houses and 21 people are found per hectare.

The size and density of the population in combination with soil characteristics was used as an indication for the risk of groundwater contamination by (dry and wet) on-site sanitation systems. Mohlaletse fits a profile with a low to possible risk. This means that on-site sanitation can be applied with no remedial environmental actions required. In Appendix 10 the table that is the basis for this conclusion is given.

Houses in Mohlaletse are generally one-storey buildings, with no water or sanitation facilities inside. Most houses are situated a place away from the street. Sanitation facilities are generally located just outside the house. The arrangement of houses differs from planned (square plots of about 3000 m^2) to chaotic. The arrangement of houses is expected to develop towards more ordered. The density of houses will most probably not increase, as the population grows slowly and there is still a large area left to which the village can expand[18]

5.2.3 Water and Sanitation in Mohlaletse village

Over 68 per cent of the households in Mohlaletse village do not have an acceptable sanitation system according to government standards (DWAF, 2001) and the vast majority of the people do not use materials for anal cleansing that cannot be used when using flushing toilets. These are two main conclusions of a questionnaire that involved 59 households. Around one third of the surveyed households use a Ventilated Improved Pit latrine (VIP). Much of these do not operate as a proper VIP. Most households use a simple pit latrine. Over one in ten of the households do not have access to any sanitation system at all. They use the mountain or a far corner on their premises. In appendix 13 the forms used for two questionnaires can be found. Results of the questionnaires are expressed in appendix 14.

The questionnaire made clear that, in Mohlaletse village, water use for sanitation is very rare. Around 93 per cent of the households do not use water for washing hands or flushing. The reason for this is most likely the scarcity of water. A lot of every-day time is spent on the collection of water. Only around 8 percent of the households use a tap on their own plot. Around 60 percent of the households use the river as primary source for their water consumption. The other 32 per cent uses one ore more of the ground water pumps that can be found in appendix 1. Contamination of the river should therefore be avoided. Collection of groundwater is not possible near every house. Near the mountains on both sides of the river, the ground water cannot be reached.

[16] For the dimensioning of a water supply project, consultant Eksteen, Van Der Walt, Nissen in Polokwane estimated the population in Mohlaletse village, using satellite images.

[17] The topographical difference between the older parts of Mohlaletse village and its extensions is basically that the former is located northeast of the river and the extensions (Lerajane and Malaeneng) southwest of the river.

[18] Land will be 'given' to marrying couples, on behalf of the acting king. These couples are generally already members of the community.

Figure 21: *Results of a questionnaire held under*

Things might be about to change, as a water supply project is on the way. This project intends to supply every person with about 60 litres of water per day, by October 2002. The water is pumped in from the Olifants River[19], and supplies are not season dependent. Walking distances between houses and the nearest water tap will not exceed 200 m. Amounts up to 30 litres per person per day are supposed to be available without charges (Mvula, 2002). According to Kruger van Eksteen, Van der Walt, Nissen in Polokwane marginal costs up to 'yard connections' are R900-1900 (90-190 Euro) per connection. Many things are unsure about this water supply project. The Fetakgomo municipality is responsible for the operation and maintenance of the water supply system. As this municipality is one of the poorer municipalities in the country, financial problems might arise. Richard Holden from the Mvula Trust says that some municipalities, who already run a water supply system, have taken radical measures to avoid bankruptcy. These range from supplying water only every other day up to stopping the entire operation.

Figure 19: *One evening I arrived in Mohlaletse village. A son of the priest had an embarrassing accident. While he was sitting on the toilet the top-structure of the (simple) pit latrine collapsed. Accidents like these are not rare in the village.*

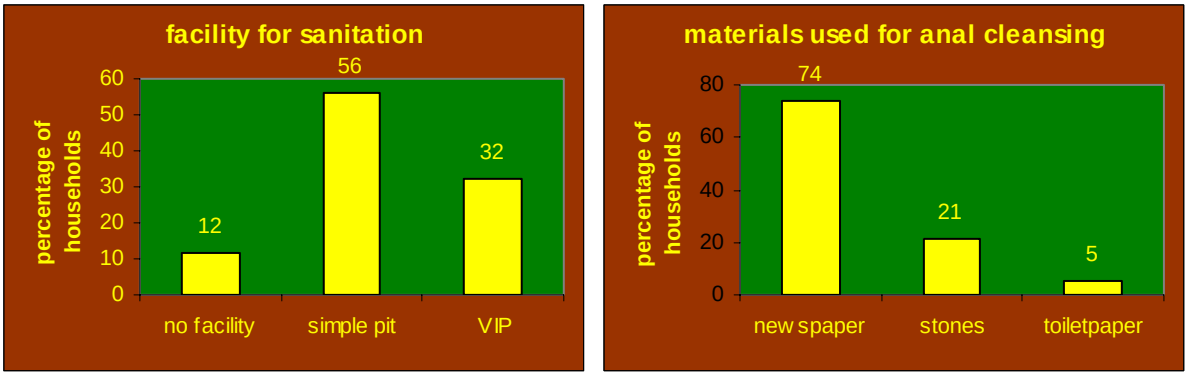


Figure 20: *Some of the results of a questionnaire held under MYSP students.*

5.3 Principles employment intensive construction

There is a basic requirement from MYSP that every working day 30 people should be trained in construction (on-the-job) over a period of several months per group every year for five years in a row. The simplicity of the construction and the employment creation per unit of expenditure are therefore important.

[19] The Olifants Rivier is a big river running through the Limpopo Province. Its water is not known for its pureness.

5.3.1 Simplicity of construction

Croswell emphasises (2.2.2) that the design of a construction work should not be physically dependent upon high standards in respect to line and level. This reduces the chances of errors in the construction and can increase the self-help potential for the households and the community. Materials used and installation methods have to be simple. Preferable, locally available materials should be used. In this paragraph, the skills and materials, available in Mohlaletse village, are discussed.

The relevant skills are the skills of members of a household and the skills of the trainees in MYSP. Households should be capable of skills appropriate for the operation and maintenance of sanitation systems. Skills of household members may differ from household to household. Therefore, necessary operation and maintenance activities should be kept as simple as possible. The trainees of MYSP should be capable of skills necessary for the construction of facilities for sanitation. The trainees in the MYSP are trained to gather construction skills, which should be appropriate for the construction of simple facilities for sanitation. In appendix 11 the skills, which the trainees are educated for, are specified. There are a few educated plumbers in and around Mohlaletse, having experience with wet on-site systems, active in or near the village.

As far as locally available materials are concerned cement, wooden poles, mud bricks, stones, river sand and even prefabricated latrine top-structures can be obtained within Mohlaletse village. Industrial manufactured materials like PVC-pipes and reinforcement steel can be bought in Polokwane at a travel distance of about 1,5 hour from Mohlaletse when using a regular car. The production of concrete toilet pans inside Mohlaletse village is a possibility that should be considered seriously. Concrete pans can be produced for less than R100 (10 Euro) per pan. The Mvula Trust has experience with this idea. In Appendix 12 the details of people involved in concrete toilet pan production are given. Simple hand washing bucket systems can also be manufactured locally and do not cost more than a few Rands. Prices of materials, estimated prices of different options for sanitation can be found in Appendix 11.

5.3.2 Employment creation per unit of expenditure

When materials from local suppliers are used, money spent on the project stays in the community. This can help to establish more jobs in Mohlaletse village, other than the ones in construction alone. The use of local contractors can stimulate local economy as well. Employment creation per unit of expenditure is dependent on the simplicity of construction, it shows the result regarding employment creation clearer than anything else.

5.4 Conclusions Selection Criteria

The description and discussion of the criteria in this chapter lead to a profile of an adequate sanitation system. The criteria are made operational for Mohlaletse village:

- **Health and hygiene:** adequate system averts spread of disease.
- **Durability:** operation and maintenance are affordable, adequate system keeps operating even when not properly used and is not dependent on support from outside the village.
- **Socio-cultural needs:** households do not have to share.
- **Physical conditions:** adequate system is not dependent on a reliable water supply.
- **Demographic characteristics:** adequate system does not contaminate water resources in Mohlaletse village, having a population density of 10-30 people per hectare.
- **Water and sanitation in Mohlaletse village:** adequate system operates when people use newspaper and stones for anal cleansing.

- **Simplicity of construction:** adequate system can be built by MYSP students
- **Employment creation per unit of expenditure:** almost all spent money stays in the community.

6.

Adequate Sanitation Systems

Now that the most critical information is uncovered and the selection criteria are discussed in chapter 5, the alternative sanitation systems from chapter 4 can be evaluated against the criteria. Doing this, issues regarding community participation (2.3) and the context of the project on sanitation (chapter 3) cannot be ignored. In this chapter, these issues are not expresses as intensely as in the next chapter. In that chapter, Strategy and Implementation, issues regarding community participation and the context of the project on sanitation are taken as a starting point. This chapter is the result of answering research question four.

Research question four:
What are adequate sanitation systems for Mohlaletse village, according to the criteria?

First, the results of a SWOT analysis are presented. This means that the most important strengths (S) and weaknesses (W), of sanitation systems, in the light of the criteria, are described. Together with these good and bad characteristics of the alternatives, the opportunities (O) and threats (T) within the area to which these systems are potentially exposed are described. In addition, the alternative sanitation systems from chapter four are brought together in a table. From this table an indication of the positive and negative sides of each alternative can be obtained.

6.1 SWOT Analysis Sanitation Systems

In this paragraph the different system groups are confronted with the criteria from chapter five. Not every separate system is discussed, but only the four groups as identified in chapter four. In 1999, Loetscher (Loetscher, 1999) gave a general indication for the appropriateness of different sanitation systems in development areas in general. This indication, in the form of a table can be found in Appendix 15. The Mvula Trust published a table with more detailed information regarding the appropriateness of sanitation systems in South Africa. This table can be found in appendix 15 as well.

The needs of the households in Mohlaletse village (1) together with the possibilities employment intensive construction (3) are related to the strengths and weaknesses of the different systems. The physical, population and water and sanitation related characteristics (2) in Mohlaletse village are related to the threats and opportunities favouring one system against another. SWOT matrices of the individual systems can be found in appendix 16. Some alternatives are ruled out and others approved. In paragraph 6.3 specific sanitation systems are proposed.

6.1.1 SWOT Matrix Dry on-site Systems

Strengths	***Weaknesses***
Needs Households (1) ► More households can be served with a proper system, with the same expenses ► Least expensive per served household: helps to increase the level of health and hygiene in Mohlaletse village fastest. ► Operation and maintenance affordable for almost all households ► High self-help potential: only one household is responsible for each single facility. ► Robust: risks of failure are low and in case of failure it only affects the household that uses the facility. ► Durability: VIDPs and Urine Diversion systems can be used for decades ► Maintenance intensity very low for VIP. ► All types of materials for anal cleansing can be used. ► Not dependant on water supply. *Principles of employment intensive engineering (3)* ► Construction materials (almost) all locally available. ► Simple construction: employment intensive construction methods. ➔ High employment creation level per unit of expenditure.	*Needs Households (1)* ► Some people dislike hole in the squatting plate. ► Cannot be placed inside the house (except for the UD). *Principles of employment intensive engineering (3)* ► No employment creation in the long term.
Opportunities	***Threats***
Characteristics Mohlaletse village (2) ► The VIP is accepted and people are familiar with its use. ► The national government approves the VIP as a basic low cost technique. Subsidies can be given to households. This is very important in the long term.	*Characteristics Mohlaletse village (2)* ► Increased water use can lead to. Collapse of pits, overflow and malfunctioning of compost production Especially if people put flush toilets in the systems. ► Most households are unfamiliar compost producing systems.

Table 8: *SWOT matrix dry on-site systems*

6.1.2 SWOT Matrix Wet on-site systems

Strengths	***Weaknesses***
Needs Households (1) ► Flushing toilet / water seal: high level of service. ► High self-help potential: only one household is responsible for each single facility. ► In case of failure, only the household that uses the facility is affected. ► Accept (small amounts of) household waste water ► Maintenance intensity is quite low *Principles of employment intensive engineering (3)* Same as for dry on-site systems.	*Needs households (1)* ► Costs of operation and maintenance not affordable to all households. ► Materials used for anal cleansing like stones and newspaper can cause blockages that causes a unhealthy situation ► If no direct water connection is available water should be poured in every time one uses the system. ► Emptying every few years is necessary (depending on the size and materials used for anal cleansing. *Principles of employment intensive engineering (3)* ► Low level of employment creation per unit of expenditure: need for mechanical emptying.

Opportunities	***Threats***
Characteristics Mohlaletse village (2) ► Costs for on-site water supply complementary to the ongoing water supply project are R900-R1900 per connection (Kruger, 2002). ► On plots larger than 1500 m^2 a system with a soak-away (aqua-privy, septic tank) is appropriate (Mvula, 2002). The area of the plots in Mohlaletse is generally larger than 1500 m^3. In the newer parts of Mohlaletse the area of the plots even exceeds 2500 m^2.	*Characteristics Mohlaletse village (2)* ► Reliable water supply cannot be guaranteed (Holden, 2002, Kruger, 2002). ► A shortage of water can cause serious problems for the proper operation of wet on-site sanitation systems. ► The municipality will try to charge individual households per unit of water consumption. ► Costs of emptying activities can become an obstacle for emptying and can threaten proper operation and the surrounding environment. Illegal dumping was done before, following finished sanitation projects (DWAF, 1997) ► The danger of groundwater contamination is larger when extra water is added. The pollution is highest with the pour flush toilet over a standard pit and lowest when using a septic tank and soak-away.

Table 9: *SWOT matrix wet on-site systems*

6.1.3 SWOT Matrix Cartage Systems

Strengths	***Weaknesses***
Needs Households (1) ► No groundwater pollution on plot will occur. ► Responsibility for the facility can be addressed to a single household, but not fully as emptying services must play a role in maintenance. ► A high level of service is offered with a flushing toilet and/or water seal arrangement. ► Cartage systems accept small amounts of grey water, but this shortens the period between the emptying activities. *Principles of employment intensive engineering (3)* Same as for dry and wet on-site systems.	*Needs households (1)* ► Costs for operation and maintenance are not affordable for all households. ► If not emptied on a regular basis bad odours and insect nuisance will be very likely. This can cause a very unhealthy situation. ► Accepts only small amounts of household waste water. When too much water is poured in, emptying might be necessary more frequent than three times a year. *Principles of employment intensive engineering (3)* ► The frequent mechanical emptying does not go along with a high level of employment creation per unit of expenditure in maintenance.
Opportunities	***Threats***
There are no relevant opportunities found, related to cartage systems in Mohlaletse village.	*Characteristics Mohlaletse village (2)* ► Effective three-yearly emptying is organisational unlikely in Mohlaletse village. The institutional requirements are not present. ► Different households have different fill-up rates. ► Disposing waste is a problem. There is no large-scale treatment facility in the surrounding area.

Table 10: *SWOT matrix cartage systems*

6.1.4 SWOT Sewerage Systems

Strengths	***Weaknesses***
Needs households (1) ► Flushing toilet / water seal: high level of service. ► Health and hygiene related aspects are maximised, but only when properly used by all users. ► Efficient, centralised treatment becomes possible. ► Accept large amounts of household waste water	*Needs households (1)* ► Costs for operation and maintenance are not affordable for all households. ► Very unhealthy situation at failure. Failure can affect the community as a whole. ► Blockages of pipes can occur trough use of inappropriate materials for anal cleansing ► Water failures can occur just like in projects similar to the ongoing water supply project: stops for periods longer than 3 weeks, municipalities bankrupt (Holden, 2002). ► Self-help potential is very low: responsible for the system is shared. ► Not robust: vulnerable to relatively small acts of misuse. An act of misuse by just one household can lead to failure of the entire system. ► Maintenance intensity is quite high. Because no failures can be accepted the system should be in top condition at any moment. Therefore, routine checks by skilled plumbers and educated users is a must. *Principles of employment intensive engineering (3)* ► Expensive both in construction and in operation and maintenance. ► Treatment works are expensive for small-scale projects like this. ► Employment creation per unit of expenditure is low. ► The majority of the construction materials is not locally available.
Opportunities	***Threats***
Other than opportunities mentioned for on-site systems, there are no relevant opportunities found, related to cartage systems in Mohlaletse village.	*Characteristics Mohlaletse village (2)* ► Reliable water supply cannot be guaranteed (Holden, 2002, Kruger, 2002). ► Water use 30 litres per capita per day cost money. At least 60 litres is needed This would mean a household should pay over R25 monthly. ► Probably more water is needed. People might choose to save money by pouring less water in the system. ► A shared system requires shared responsibility and (financial) response in case of failure. This requires an institutional system, which is not present.
Viljoen gives a general comment on the differences between sewerage systems. The savings of a system with a small-bore disposal system to stabilisation ponds over a conventional waterborne sewerage system are marginal and experience in other countries has indicated that in the medium and long-term high maintenance costs are inevitable (Viljoen, 1988).	

Table 11: *SWOT matrix sewerage systems*

Figure 21: *water reservoir under construction for a water supply project in Mohlaletse village*

6.1.5 Criteria Matrix

To give a clear picture of all the alternative sanitation systems that were analysed a matrix was made in which the alternatives are confronted with the selection criteria. This matrix, presented in table 12 can just be used as an indication.

	Sanitation System	VIP	VIDP	UD	Pour-flush toilet	Aqua-privy / Septic Tank and soak-away	Conservancy tank	Full-bore waterborne sewerage	Small-bore solid free sewerage	Shallow Sewerage
Needs households	*Health and Hygiene*	+	+	+	++	+	0	0	+	+
	Durability	+	+	+	0	0	--	--	-	--
	Socio-cultural needs	+	-	-	+	++	+	++	++	++
Characteristics Mohlaletse village	*Physical conditions*	+	++	++	0	0	+	--	0	-
	Demographic characteristics	+	++	++	0	+	+	-	0	0
	Water and sanitation	++	++	++	0	0	0	--	0	0
Employment Intensive	*Simplicity of construction*	++	+	0	+	+	0	--	0	0
	Employment-creation per unit of expenditure	++	++	++	++	+	--	--	0	0

Table 12: T*he alternative sanitation systems against the criteria.*

The values in table 12 should only be used as an indication for the adequateness of the alternatives. Some of the criteria are so important that if an alternative scores low for that criteria, the alternative should be considered as inadequate. These criteria are:

- Health and hygiene
- Durability
- Physical conditions
- Water and sanitation
- Employment creation per unit of expenditure
- Simplicity of construction

'Socio-cultural Needs' vary over the population and 'Demographic Characteristics' vary over the area of the village.

6.2 The adequate alternatives

There are three alternative sanitation systems that can be regarded as adequate for most households in Mohlaletse village. These alternatives are the VIP, the UD and the VIDP. Basically, if a VIP is not possible, a UD is the best option. If households have a reliable water connection and are economically above average developed (so they can afford toilet paper and flushing water), wet on-site sanitation can become an option, but only when households have made an informed choice for such a facility. An aqua privy and soak-away is the best alternative in this case.

Cartage systems are not adequate because of their low durability and high costs for operation and maintenance requirements. The institutional requirements for a system like the conservancy tank are not available. This becomes even more of a problem when there are only a few tanks in an area of several hectares, which do not have the same fill-up rates.

Sewerage systems are not adequate because of the durability (including affordability) and the physical conditions in Mohlaletse village. Demographic characteristics are not in favour of sewerage as well, because the households in Mohlaletse village are widely spread. As it is strongly recommended that households should make a choice of their own, it is very unlikely that more than a few adjacent household plots would prefer a wet system. The extra value of small-bore sewerage over separate wet on-site sanitation facilities is marginal, as the effluent of the latter can be dealt with on-site using a soak-away.

Possibilities for upgrading could be kept open. However, one should not become too concerned with upgrading in low-income areas like Mohlaletse village. It is unlikely that all the villagers of Mohlaletse will be able to afford upgrading services at the same time, which will be necessary if one wants to upgrade upto (full) waterborne sanitation (CSIR, 1991 and Holden, 2002).

6.3 Proposed sanitation systems

The over-all recommended method for sanitation is the Ventilated Improved Pit latrine (VIP). Households should get the opportunity to choose for other facilities. These secondly recommended facilities are:

- **Dry-on-site:** *Urine Diversion toilet:* This is the best dry on-site alternative In areas where a VIP is not possible, because of thin soils for example. Close to where groundwater is collected this system can also be a safer solution than the VIP.
- **Wet-on-site:** *Pour-flush toilet* In areas that are not densely populated and where the people have money for flushing water and toilet paper *The aqua privy and soak-away.* In more densely populated areas and where people have money for flushing water and toilet paper.

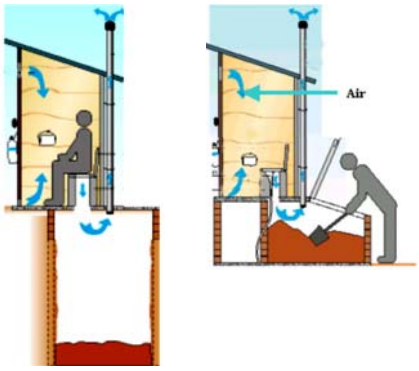


Figure 22: *Adequate dry on-site systems. Left: VIP (VIDP appendix 9), Right: UD*

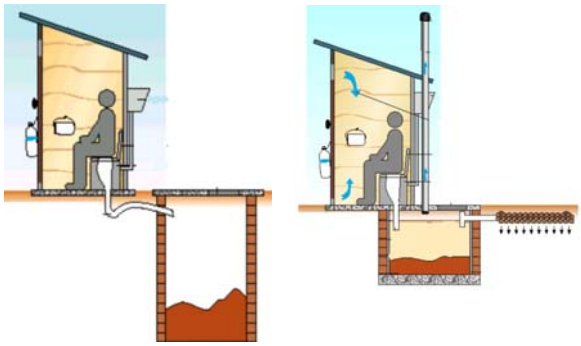


Figure 23: *Adequate wet on-site systems. Left: Pour-flush toilet, Right: Aqua-privy and soak-away*

7.

Strategy and Implementation

In this chapter a possible strategy for the decision-making for household owned sanitation facilities is given. In addition some recommendations for the physical implementation are done. Now that specific sanitation systems have been approved, one big question still stands. This question is the final research question.

Research question five:
How can the MYSP management help to improve sanitation in Mohlaletse village?

In answering this question the researcher used two issues as a starting point for a strategy that can be followed by the MYSP management. These two issues are the context of the research and the principles of community participation.

7.1 Strategy for Decision-making

In this paragraph a view on the best way to cope with employment intensive sanitation project in Mohlaletse village is expressed. This means a clear strategy on how to communicate and work together with the different stakeholders in the project environment. To come to this strategy use is made of the principles of community participation as much as possible. The stakeholders that were addressed in the stakeholder analysis (3.3) can all play their role in the project. During the different phases of the project, different stakeholders are likely and preferably to be involved.

The overseas Development Association divides a development project into four stages. During these stages there are basically four types of participation, which are: being informed, being consulted, working together in a partnership with the MYSP management or being controlled by this management. In table 13 the ideal considered stakeholder participation is presented. This table gives a situation that is preferable. The operational MYSP management (LITE) should make effort to realise such a situation.

Participation matrix				
Type of participation **Stage in cycle**	**Inform**	**Consult**	**Partnership**	**Control**
Identification	-Households -Trainees -Paramount Chief	-Households -Trainees -Marota Forum -Mvula Trust -Municipality	-Community based contractors	-Fetakgomo -Paramount Chief
Planning	-Households -Fetakgomo -Usobomvu	-Households -Community based contractors		
Implementation		-Households -Trainees -Community based contractors		
Monitoring & Evaluation		-Households -Community based contractors	-	

Table 13: *participation of stakeholders in the different phases of the project.*

Prototypes of the adequate systems should be in place before the end of the identification stage. In appendix 17 is explained how the stakeholders should preferably participate. The CSIR (CSIR, 1991) emphasises that wherever possible the user should be encouraged to build its own superstructure. The most logical and practically only possible solution within the framework of MYSP is to start constructing facilities at premises of households that include a MYSP-student. This can very much influence the motivation of the trainees. For the project to become a success, it is strongly recommended to let the participating households make an informed choice for a certain alternative sanitation system themselves. Choosing can be done by showing a household representative a practical example. This household representative can be a member of a committee for development. The Marota Forum (appendix 3) is probably an appropriate committee to work with. Another way for choosing is to construct prototypes of the adequate alternative sanitation systems. A large advantage of constructing these prototypes is that valuable information on the construction of the alternatives can be gathered. Information on construction costs, construction materials and employment creation per alternative can be obtained in this process. The trainees of MYSP get the opportunity to learn the details about every adequate alternative. When the trainees get the chance to choose for an alternative they can be regarded as 'able to make an informed choice', but can also help the head of their household to make this choice.

There are a number of aspects households should be made aware of before an informed choice can be made. These are:

- Costs of construction (if households have to pay themselves, partly)
- Costs of maintenance and operation
- Essential acts to keep the system operational and hygienic
- Responsibilities at failure

During the training programme these aspects can be taught to the trainees.

A type of latrine can be constructed with a variety of superstructures, seats etc. It is preferable that a household chooses and pays for its own superstructure. The simplest form of appliance is a plain seat or pedestal, or a squatting plate (CSIR, 1991). Differences between alternative pans for flushing are described in Appendix 9.

7.2 Implementation

There are standard designs for the construction of simple facilities like VIP, VIDP and UD. There are checklists that contain principles by which a single pit VIP, VIDP and UD system must operate. One such a checklist can be found in Appendix 18.

Several documents contain standard designs for pour-flush toilets and aqua privies. The designs can be constructed using the following locally 'produced' materials:

- Concrete / mud bricks
- Concrete parts
- Wooden poles
- River sand

For up to date designs Mvula Trust, a South African NGO for water and sanitation can be contacted. Because of its experience, this NGO can provide a lot of information on business plans[20], subsidies and new developments in water supply and sanitation.

7.3 Conclusion Strategy and Implementation

Strategy:
Households in Mohlaletse village, including a member that is being educated in MYSP, are given the opportunity to make an informed choice for a sanitation system. The students in MYSP should first be trained by constructing different (adequate) sanitation systems. These physical examples / prototypes can be very useful in giving households the opportunity to make an educated choice.

While constructing the examples, costs of construction and materials and the amount of hours of created employment should be reported. A sanitation system can be constructed with a variety of superstructures, seats etc. It is preferable that a household chooses and pays for its own superstructure. It should be stimulated to use local materials.

[20] For information on Sanitation Business Plans Richard Holden from the Mvula Trust can be contacted. His personal details can be found in appendix 12.

8.

Conclusions and Recommendations

In this final chapter the conclusions of the research are given. These conclusions form the answer to the problem formulation of this research. The coverage of the main objective is subject to the reflection of the results in section 8.2.1. The research process and the used theories are discussed in sections 8.2.2 and 8.2.3 respectively. In addition, recommendations towards the Mohlaletse Youth Service Programme- management are done in section 8.3.

8.1 Conclusions

The majority of households in Mohlaletse village are in need of a sanitation system with the following profile. An adequate system will avert the spread of disease among its users and the community (Health and hygiene). Its operation and maintenance requirements are affordable to the households and the system keeps operating even when not properly used (Durability). Most households do not want to share the responsibility for proper operation and maintenance (Socio-cultural needs).

An adequate system is not dependent on reliable water supply (Physical conditions). A system should not contaminate water resources in Mohlaletse village, having a population density of 10-30 people per hectare (Demographic characteristics) and the system must operate in spite of the use of newspaper and stones for anal cleansing (Water and sanitation in Mohlaletse village)

System designs should be simple enough for the constructed by MYSP students (Simplicity of construction) and almost all spent money should stay in the community (Employment creation per unit of expenditure).

An appropriate way for meeting the needs of households in Mohlaletse village can be realised by the construction of one of the five adequate sanitation systems for each participating household. These adequate alternatives are the Ventilated Improved Pit latrine (VIP), Ventilated Improved Double Pit latrine (VIDP) and the Urine Diversion toilet (UD) most households in Mohlaletse village.

For households that use toilet paper for anal cleansing and a ground water tap on their plot, two other systems are adequate as well. These systems are the Pour Flush toilet and the Aqua-privy and soak-away.

Dry on-site sanitation systems have the largest improvement potential for the village as a whole, because these systems help to increase the level of health and hygiene in Mohlaletse village faster than any of the other alternatives. They are easy to build and construction costs per facility are low. The relative low costs for operation and maintenance of dry on-site systems make them affordable for almost all households in Mohlaletse village. In addition,

dry on-site sanitation systems have the smallest chance of failure, independent on the economic status of the user. This makes them more hygienic in the long term.

Community participation in decision-making and construction is the key to acceptance and effective user education. The construction of the adequate alternatives makes use of local materials and the skills of MYSP-students and local contractors possible. This stimulates the local economy and the availability of knowledge in the community.

An adequate strategy for a sanitation project in Mohlaletse village by MYSP can be formulated as follows: Households in Mohlaletse village, including a member that is being educated in MYSP, are given the opportunity to make an educated choice for a sanitation system. MYSP should first be trained by constructing different (adequate) sanitation systems. These physical examples / prototypes can be very useful in giving households the opportunity to make an informed choice.

There are several documents that contain standard designs for the five adequate sanitation systems. The designs can be constructed using locally 'produced' concrete / mud bricks, concrete parts, wooden poles and river sand. While constructing the examples / prototypes, costs of construction and materials and the amount of hours of created employment can be reported.

8.2 Reflection

In this reflection, the results of the research comments are given on three main aspects of the research. First, the extent to which the research objective was reached is discussed. Then, the research process is discussed. A few choices that were of great importance for outcome of the research are described. An in addition, something is said about the adequateness of the used theories.

8.2.1 Results

The realisation of the research objective is divided into three sub objectives. These are the identified criteria, the identified adequate sanitation systems and the proposal for improving the sanitation infrastructure by MYSP.

The criteria that are considered to be most important for a sanitation project, according to international and local experts were made operational for the situation in Mohlaletse village. The interests of the Mohlaletse Youth Service Programme were taken into account as well. No quantification of the importance of the identified criteria was done and no single best option was selected. Instead, five alternatives were identified as adequate. This means that none of the eight identified criteria forms a direct obstacle for these five sanitation systems. Pickford argued that no technology should be chosen for a community by outsiders (section 2.3). This means that even if it was possible to make a balanced quantification of the criteria, no single best option should have been the result of this research.

The fact that five different systems are adequate does not mean that all households can afford to use any of the five systems. The main reason for not approving one single option is the large difference between individual households. In this report, no ready designs are included. This might be a handicap for starting up the project but it does leave open the possibility for experiments with local materials for the construction of prototypes.

The fact that five different systems are adequate emphasises the need for a clear strategy and implementation proposal, in order to give households the chance to choose an adequate system that meets their needs best. The strategy includes practical advice, but the MYSP-management can and should work out this 'general idea' in detail.

Some aspects on which the conclusions are based are unsure. A few criteria were based on the expectations of experts. The future situation regarding water supply and demographic characteristics is not expected to change much compared to the current situation. But if it does, other systems might become adequate. If the economic situation changes, other systems might become options in the years to come.

The alternative systems are not the only technical options. These selected ones are in line with government policy, but other systems or improved versions of the systems in line with government policy, could have been adequate for this project as well.

8.2.2 Research Process

Many choices had to be made in this research. These choices influenced the outcome of the research to a certain extent. Looking back, tasks and responsibilities of the different stakeholders should have been uncovered clearer and earlier in the research process. With a clear insight into the tasks and responsibilities of the stakeholders, the MYSP-management could have communicated and cooperated more effectively with the most influential stakeholders in an early stage of the project.

The choice for working with government approved sanitation systems alone narrowed the view to some extent, but made way for intensive research in other fields, like community participation. On the other hand, all nine alternatives were analysed. A rejection of a few systems in an earlier stage of the research would have left more time for research regarding strategy and implementation. Such an early rejection would have been possible if the Mvula Trust was contacted in an early stage of the research. A proposal for the local manufacturing of toilet pans and toilet top structures could have been written.

At the start of the research process, the ideas of James Croswell, based on experience, were considered as adequate for the situation in Mohlaletse village. These ideas concentrated around a Small-bore solid free Sewerage system that was successfully applied in a South African township in the nineteen eighties.

The research concentrated on the adequateness of nine different sanitation systems, including the small-bore solid free sewerage system. This means a balanced evaluation was done. A different choice in the research process could have been the evaluation of the small-bore solid free sewerage system. The conclusions of that evaluation could have been used to optimise that system or look for other systems as an alternative to the small-bore solid free sewerage system. Conclusions of such a research would not have been very different from the ones in this research. The only difference would have been that a very clear conclusion about the adequateness of the small-bore solid free sewerage system could have been drawn.

8.2.3 Used Theories

The use of the theories of Employment Intensive Construction as it is used at the University of Twente reflected in the definition of Mosch (Mosch, 2000), ensured a focus on the long-term effects of the project. If a different definition of Employment intensive Construction was used, the long-term effects would have been under addressed. These long-term effects are the same ones that were the basis for starting up MYSP. The theoretical focus should have been more on community development and community based construction.

Theories and experience reports on community participation were very useful for the understanding of traditional relations in the community. The concentration on these relations has left the role of the recently established municipality a little under-exposed.

8.3 Recommendations

The MYSP-management should not be too concerned with upgrading of several on-site sanitation systems to a network system, like small-bore solid free sewerage in Mohlaletse village. It is unlikely that all many different villagers will be able to afford upgrading services at the same time, which is necessary if one wants to upgrade to a shared network sanitation system. A shared network system requires shared responsibility and (financial) response in case of failure. This requires an institutional system that is new to the community of Mohlaletse village.

Wherever possible a future user of a sanitation system should be encouraged to build its own system or at least a superstructure. The most practical and possibly only solution within the framework of MYSP is to start constructing facilities at premises of households that include a MYSP student. This student should be involved in the construction of a sanitation system on the plot of his or her household. This can be of great value for the motivation of the MYSP students. In addition, the future users can be educated relatively easy on sanitation related issues through the Mohlaletse Youth Service Programme. Following this thought these three recommendations are done:

- The MYSP management (LITE) should give households in Mohlaletse village, including a member that is being educated in MYSP, the opportunity to make an educated choice for one of the five adequate sanitation systems that meets their personal needs.
- MYSP students should first be trained in constructing different (adequate) sanitation systems. These physical examples / prototypes can be very useful in giving households (students) the opportunity to make an informed choice. The prototypes should include the following systems
  - Ventilated Improved Pit latrine (VIP)
  - Ventilated Improved Double Pit latrine (VIDP), preferably with urine diversion.
  - Urine Diversion toilet (UD)
  - Pour-flush toilet
  - Aqua privy and soak-away

  A sanitation can be constructed with a variety of superstructures, seats etc. It is preferable that a household chooses and pays for its own superstructure. It should be stimulated to use local materials

- While constructing the examples / prototypes of the five adequate alternatives the MYSP-management should report costs of construction and materials and the amount of hours of created employment the. Standard designs should be tested and improvements in designs should be considered. The design team has to remain closely involved with the project so that any necessary adaptation to the design can be made during the period of construction. If on-site wet systems are constructed by and for any of the households, testing of the effects on ground water resources should be organised for the prototypes as well. This means that the prototypes should be in use for some period of time.

There are a number of aspects households should be made aware of before an educated choice can be made. Special attention should go out to costs of construction, costs of maintenance and operation, essential actions to keep the system operational and hygienic and responsibilities at failure.

According to the White paper on Basic Household Sanitation municipalities are responsible for assisting households to provide their own sanitation facilities. As part of this process, it must make the households aware of the importance of sanitation and the implications it has for their health. It is recommended to approach the municipality and urge it to make efforts to increase this awareness.

Bibliography

Croswell, J., *Labour based construction of the Ilinge Republic of Transkei*, 1986

CSIR, Division of Building Technology, *'Guidelines for the provision of engineering services and amenities in residential township development*, 1991

DWAF: Department of Water Affairs and Forestry of South Africa, *A protocol to manage the potential of groundwater contamination from on site sanitation*, 1997

DWAF: Department of Water Affairs and Forestry of South Africa, *White paper on basic household sanitation,* 2001

Franceys, R et al., *A guide to the development of on-site sanitation,* 1999

Hanæus, J et al. *A study of a urine separation system in an ecological village in northern Sweden,* 1997.

Jackson, M, Paper: *Sanitation quality principles*, 1994.

Kalbermatten et al, *Appropriate sanitation alternatives, A Technical and Economic Appraisal,* Worldbank Studies in Water Supply and sanitation 1, 1982a

Lewis W.J., Farr, J.L. and Foster, S.S.D, *The pollution hazard to village water supplies in eastern Botswana, Proc.Invstn.Civ. Engrs,* Part 2, June 281-293.

Llewellyn, *Private rain measurement station data between 1997 and 2002,* Apel, 2002.

Loetscher, *Thomas, Appropriate sanitation in developing countries: The development of a computerized decision aid,* The university of Queensland, Brisbane, Australia, 1999

McCommon, C. et al., *Community management of rural water supply and sanitation services,* UNDP-World Bank, 1990

McCutcheon, R.T., *Employment creation in Construction in South Africa: the potential and the Problems,* University of the Witwatersrand, Johannesburg, published in ATC, volume 33, June 1993.

Mosch, L. et al., *Employment Based Civil Engineering,* University of Twente, 2000

Mvula Trust, *Newsletter of the Mvula Trust*, March 2002.

ODA: Overseas Development Administration, *Guidance note on how to do a stakeholder analysis of aid projects and programmes*, ODA, July 1995.

Pardeller, L. Sister, *International water management institute, 1999*

Philips, Meyer, McCutcheon, *Urban Forum*, volume 3, nr. 2, 1992.

Pickford, J, *Low cost Sanitation,* IT publications London, 1995

Poodt, E., *A socio-economic analysis of Mohlaletse,* Hanzehogeschool Groningen, 2001.

Pool M.M.L, *Development of a Programme Strategy and project Manual for the Sekhukhuneland Development Programme,* University of Twente, 2001.

Schiller, E. J. et al. *Water supply and sanitation in developing countries, Butterworths,* Ann Arbor, Kent, England, 1982

Shabalala, Research project report, *Sanitation in Mohlaletse*, WITS University, 1999

Taylor Parkins, F., *Mohlaletse youth service programme*, Draft Project Roll-out & Progress, Jan 2002.

Viljoen, P.S., *Housing infrastructure for developing communities*, Van Wyk en Louw Inc. Consulting Engineers, 1988

Willems, D., Vos, M., *The opportunities for bicycle transport in Mohlaletse,* University of Twente, 2001

Interviews

Interviews held between the 3th of April and the 26th of August 2002:

Experts Engineering and Sanitation.

- **James Croswell** from James Croswell and Associates, a consultant in engineering
- **Richard Holden** from the Mvula Trust, a South African NGO in the field of water and sanitation
- **Mark Van Ryneveld**, a former research feller at the University of the Witwatersrand involved in rural sanitation
- **Wim van Steenderen**, a former research feller at the University of the Witwatersrand involved in engineering. He is now a teacher in the Mohleletse Youth Service Programme in Mohlaletse village.

Local experts in Mohlaletse village

- **Matjie Davis**, a former Ward Counsellor of Mohlaletse village. He is now a teacher at a school in Mohlaletse village.
- **Jacques Kruger** from Eksteen, Van Der Walt, Nissen in Polokwane. He is involved in the planning and implementation of a water supply project in the area where Mohlaletse village is located.
- **David Llewellyn** from the Bapedi Store that sells a wide variety of construction parts, most not locally produced. He has lived and ran his business near the village over the last 8 years.
- **Matiba Lazarus**, an experienced plumber just outside Mohlaletse village.
- **Phileman Sekwati**, a pastor and leader of the Alliance Church of South Africa in Mohlaletse village and member of the Marota forum for the development of Mohlaletse village.
- **The current ward Counsellor** of Mohlaletse village

Improving Sanitation in Mohlaletse Village

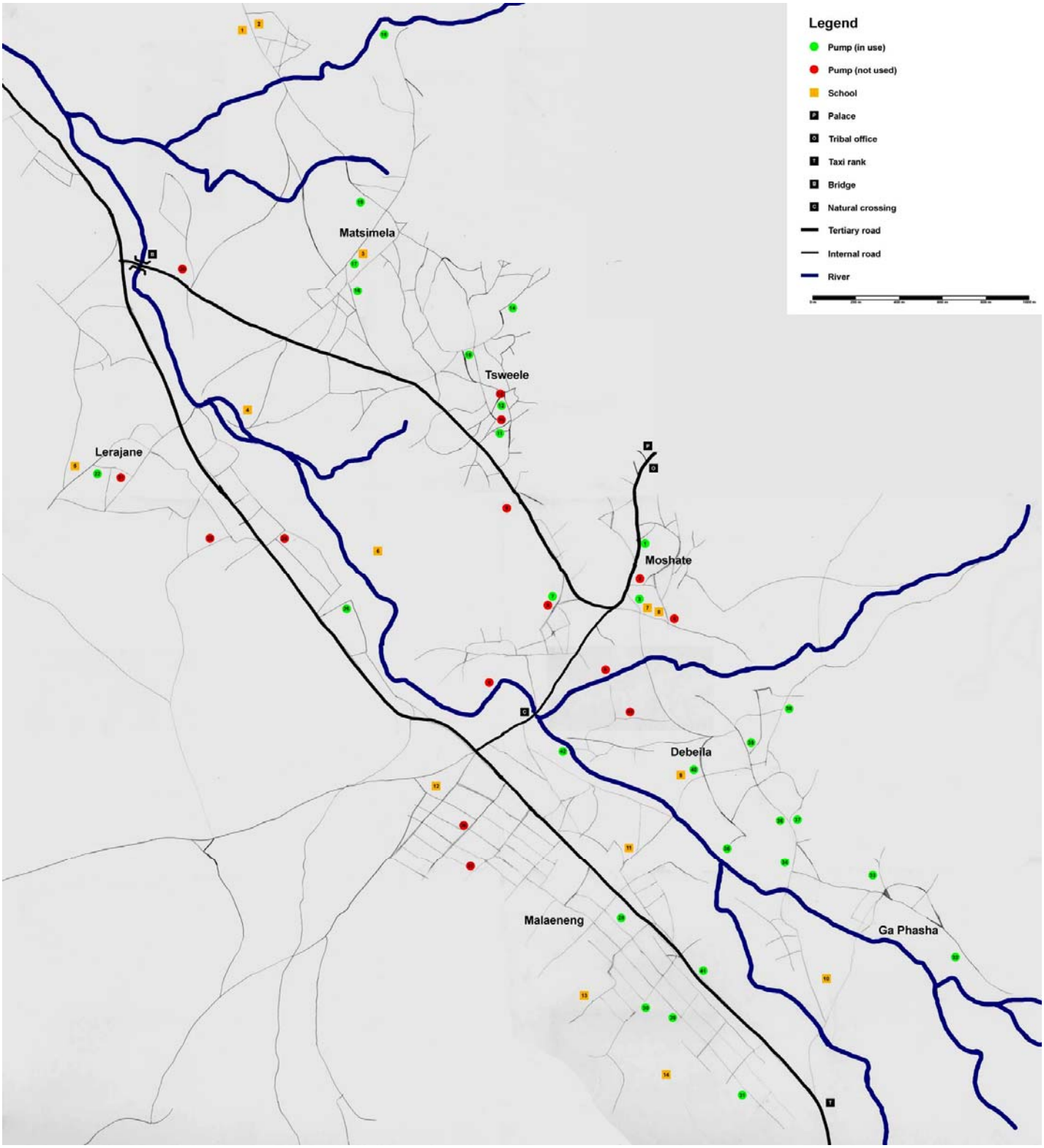
Community based approach for the Employment-intensive construction of Sanitation facilities as part of the Mohlaletse Youth Service Programme

Master Thesis Civil Engineering by Pieter van Oel
20 November 2002, University of Twente, The Netherlands

Appendices

Table of contents

1 Map of Mohlaletse village



Appendix Figure 1: *Map of Mohlaletse village made by University of Twente-students Daan Willems and Guido Vos in 2001*

2 Traditional political structure in Mohlaletse village

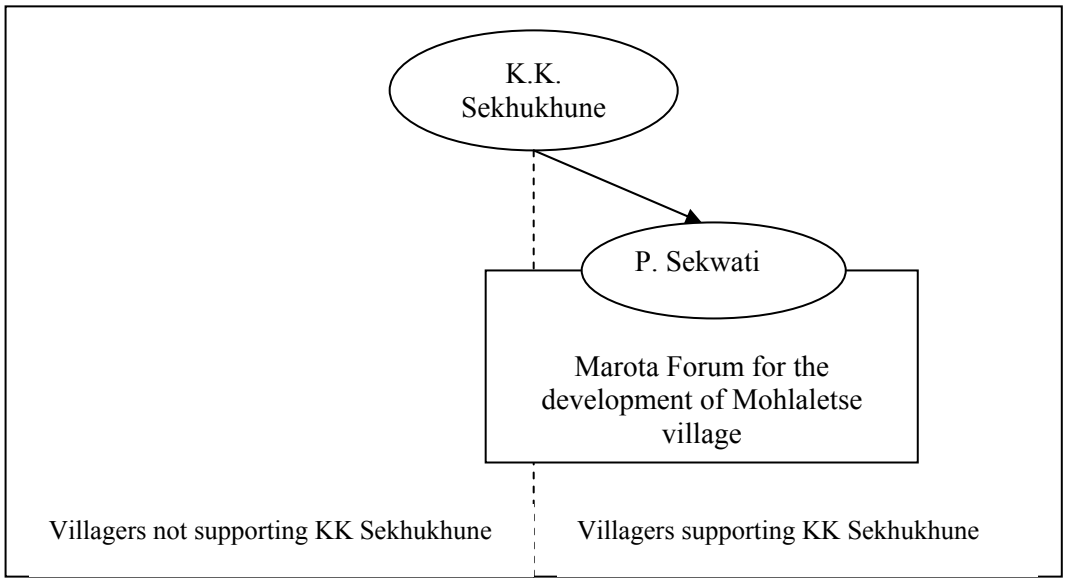
Mohlaletse village is ruled by a king. Today's king, K.K. Sekhukhune, is officially 'acting' king. A 'real' king would be a son of the previous king and his a democratically chosen wife. K.K. Sekhukhune is not the son of the democratically chosen wife, but of a wife chosen by the king himself, instead.

In the community there is a man who could officially be king. At the time he was to become king, he was not willing to and he left the village. Years later he came back and wanted to become king. About two decades ago, the South African legal court judged that K.K. Sekhuhune was allowed to keep his authority. About half of the population supported this decision and the other half protested. Some villagers were killed (Davis, 2002).

The people who support K.K. Sekhukhune are generally the somewhat richer people in the village. LITE is working closely together with the Alliance Church of South Africa in Mohlaletse village. The theory-lectures of MYSP are held at the ACSA church building. The head of this church, Philemon Sekwati, is K.K's right hand and head of the Marota forum for the development of Mohlaletse village. This forum is not democratically chosen (Davis, 2002).

The poorer people in Mohlaletse village need special attention because they might not get the attention they deserve from the community leaders.

Appendix figure 2: *A bus of the Alliance Church in Mohlaletse village. This bus is used for purposes both related and not related to church activities.*



Appendix figure 3: Two groups of villagers divided by events in recent history.

3 Short description Stakeholders

In this appendix, the stakeholders are described briefly.

Primary stakeholders

Trainees
Sixty men and women from Mohlaletse village take part in the first phase (first year) of the Mohlaletse Youth Service programme. These local people, in the age between 16 and 35, are educated to gather skills ranging from basic life skills to construction skills. As part of the training programme the trainees will execute construction activities for the realisation of the improved sanitation proposal.

Households in Mohlaletse village
The population of Mohlaletse village (about 17 000), can be divided into around 2500 households with approximately 7 members. Most household are making use of a facility for sanitation (mostly a toilet with a latrine) situated on their own property. The households are the stakeholders be served with improved sanitation systems.

Secondary stakeholders

National government
The national government establishes legislation and standards. These guide, co-ordinate and monitor national sanitation programmes. The department of water affairs and forestry (DWAF) provides support to other (lower) levels of government, regulates service provision and intervenes where there is lack of capacity. DWAF emphasizes that providing improved toilets is just one part of improving sanitation. At the same time there has to be improved community knowledge on health matters, improved hygiene and community participation in sanitation programmes. (DWAF, 2001).

Limpopo Province Government
According to DWAF provincial government must provide finance, human resources and technical support to local governments. They must also ensure compliance with national policy, develop enabling legislation, co-ordinate regional planning and monitor progress (DWAF, 2001).

Municipal Government (Fetakgomo)
It is the municipality who is in the first instance accountable for the provision of sanitation services and to promote health and hygiene awareness and to monitor the health of its communities. The municipality is similarly responsible for ensuring an environmentally safe approach to sanitation and for monitoring the impact of the sanitation process on the environment. Local government planning takes place through the Integrated Development Plans (IDPs) - of which the Water Service Development Plans (WSDPs) are a component. In order to implement sanitation improvement programmes, local government must budget and source funding for this purpose. Local government must also plan and budget for the operation and maintenance of sanitation systems. It is also responsible for assisting households to provide their own sanitation and to build their own toilet facilities. Specific responsibilities include:

- ► Making communities aware of the importance of sanitation in terms of health.
- ► Launching, together with the communities, health and hygiene promotion programmes.
- ► Monitoring the health of communities.
- ► Assisting households to operate and maintain sanitation facilities.

(DWAF, 2001).

Municipal services available include subsidies per household
For labour and materials R **900**
For health and hygiene education R **300**

Marota – Mohlaletse Development Forum
This traditional forum has a local expert for the following fields: Water, Road, Health, Education, Youth, Environment and tourism, Farming, Sports, Arts and culture, Women affairs and Disability. The head of the forum is Pastor Philemon Sekwati of the local Aliance church of South Africa.

Umsobomvu Youth Fund (UYF)
In 1998, the South African Minister of Finance announced the government's decision to create the Umsobomvu Youth Fund. The fund was established to create a platform for job creation and skills development for young people. The UYF has been operational from January 2001.

The key to the 'Umsobomvu approach' is to increase knowledge and experience of the South African youth. This is done by employing them and provide an additional training. "The planning for the Mohlaletse Youth Service Programme (MYSP) involves 5 years of training and 550 participants. UYF will contribute 6 million Rand (approximately US$600.000) for the first two years. After that, another 30 million Rand (US$3 million) will be invested for the entire project" (Ellen Poodt).

Joint Enrichment Project (JEP)
JEP contributes to the MYSP by teaching 'Life Skills', Life skills include dealing with contracts, banking, and being educated on the dangers of HIV/AIDS. Education on health and hygiene related to sanitation could become part of it

Project Literacy
Teachers from this organisation are teaching students in 'Adult Basic Education & Training (ABET). ABET includes lectures in English language and mathematics.

Research Centre for Employment Creation in Construction (WORK)
WORK is part of the NetWORK coalition[1] and basically has the following objectives:

- To carry out multi-disciplinary research into variable aspects of employment-intensive construction;
- To disseminate the results of the research, particularly the implications for the planning and implementation of employment generation programmes; and
- To develop skilled human resources in the field of employment-intensive construction in particular and in the field of development in general. (work, 2002)

Labour Intensive Training and Engineering (LITE)
LITE is part of the NetWORK coalition. The company was established in November 2000 and has the following objectives:

[1] The NetWORK organisation was established in 2001. NetWORK's core is the WORK Research Centre for Employment Creation in Construction. NetWORK further consists of two companies, Employment Intensive Engineering Consultants (Pty)Ltd (EIEC), and Labour Intensive Training and Engineering (LITE).

- Empower local people by training them in technical and managerial skills;
- Improve the physical structure of rural areas (roads, storm water drainage, water supply);
- Fuel the local economy as much as possible through the wage bill and local purchase of required materials as a substantial part of the construction (Pool, 2001).

James Croswell Associates
James Croswell Associates is a private company consisting of approximately 30 people. As an officially registered consultant, James Croswell Associates takes the responsibility for the design and contractual arrangements and provides professional indemnity for the projects and its members.

Employment Intensive Engineering Consultants (EIEC)
EIEC is specialised in the promotion and implementation of appropriate engineering technologies and policies for infrastructure construction and development. Prof. R.T. McCutcheon and Mr. J. Croswell are the founders of the company. EIEC is the commercial consulting partner in the NetWORK coalition.

Community based contractors
Locally based contractors are essential for the sustainable development of the community. Therefore, it is very important to include these service providers in the project. During implementation, but during selection and planning activities their potential services should be taken into consideration as well.

Paramount Chief of Sekhukhuneland
The paramount chief of Sekhukhuneland, of which Mohlaletse village is the capital, is K.K. Sekhukhune. He owns in fact all the land on which the people in Mohlaletse village are living. He has good understanding with mister Donaldson of the Donaldson Trust and he is well respected in the community.

The Church
The church has a very good understanding with LITE mister Donaldson, K.K. Sekhukhune and of course the population that attends the church. The church is the location where the theoretical part of the training programme takes place.

Mister Donaldson
Mister Benjy Donaldson is founder and owner of the Donaldson Trust. This trust is the initial sponsor and instigator of the development of engineering services in the village of Mohlaletse (Sekhukhuneland). The Trust was founded in 1936. The Trust has concentrated on the rural areas since 1987.

Because Benjy Donaldson has been in contact with the community of Mohlaletse since the beginning of the 1980's, he was the first contact person for WORK and LITE with the community. Benjy Donaldson has very good, informal, relations with the paramount chief of Sekhukhuneland. Mister Donaldson is not necessarily to be involved in the project, but is a very valuable contact person.

Mvula Trust
This is a South African organisation involved in water supply and sanitation. The trust has huge experience in several rural areas in South Africa and assists local governments. The Trust has developed a community-managed approach to sanitation. What they do comes down to the following:

- Develop community awareness of the need for sanitation programmes and projects.

- Help communities to access sanitation subsidies (for example under the Department of Water Affairs and Forestry programme the subsidy is R600 per household)
- Identify all the relevant structures within the community and facilitate the formation of sanitation committees
- Train sanitation committees to manage sanitation projects thus maximising community management in all the phases of the project cycle
- Provide mentorship and gradually withdraw

4 Government policy principles for sanitation

The general policy principles of the South African national government are represented in the White Paper on Basic Household Sanitation in 2001 (DWAF, 2002):

- Sanitation improvement must be demand responsive, supported by an intensive Health and Hygiene Programme
- Community participation
- Integrated planning and development
- Sanitation is about environment and health
- Basic sanitation is a human right
- The provision of access to sanitation services is a local government responsibility
- "Health for All" rather than “all for some”. Equitable regional allocation of development resources
- Water has an economic value
- Polluter pays principle
- Sanitation services must be financially sustainable.
- Environmental integrity

The government intends that its local bodies (Provinces and Municipalities) will address problems by means of the following strategic interventions:

- Facilitating the participation of communities;
- Promoting health and hygiene awareness and practices;
- Development and use of local resources;
- Upgrading of existing facilities;
- Adopting an integrated environmental management approach;
- Developing a common approach to implementation; and
- Undertaking specific programmes to clear the backlog.

o 5 Definitions Importance and Influence in Stakeholder analysis

Stakeholders are associated with importance to the project's successfulness and their relative power/influence. The used definitions for importance and influence are given in this appendix.

Importance
Importance indicates the priority given to satisfying stakeholders' needs and interests through the project. Importance is likely to be most obvious when stakeholder interests in a project converge closely with objectives of the project.

Influence
Influence is the power, which stakeholders have over a project - to control what decisions are made, facilitate its implementation, or exert influence, which affects the project negatively. Influence is perhaps best understood as the extent to which people, groups or organisations (i.e. stakeholders) are able to persuade or coerce others into making decisions, and following certain courses of action.

Importance is distinct from influence. There will often be stakeholders, especially unorganised primary stakeholders, upon which the project places great priority (e.g. women, resource poor farmers, slum dwellers, ethnic minorities etc). These stakeholders may have weak capacity to participate in the project, and limited power to influence key decisions.
(ODA, 1995)

6 Experience with composting latrine and VIDP

In a neighbouring community, in the village of Apel, a compost-producing toilet was placed. This toilet was placed next to a community centre funded by the Irish government.

According to David Llewellyn, a villager, this facility is not frequently used because:

- It is not easy to use for older people, because of stairs.
- It is not clear who should profit from the compost.
- Other reasons he gives are more culture related:
- People are afraid that people can see them from below, through the compost opening
- People think it is too fancy and reserve it for quests

Appendix figure 4:
UD toilets in Apel are not used.
Main reasons: Old people get tired using stairs, communal use and responsibility for maintenance can not be addressed.
Right: door for emptying toilet.

Experience with a VIDP showed that this system is highly dependant on the permeability of the soil. It should not be applied as the alternative for a single pit when rocky soil conditions do not allow a VIP.

Appendix figure 5: *Unhygienic emptying of a VIDP. Urine does not flow out because the soil is not permeable enough*

7 Stakeholder Analysis: Stakeholders interests

For each stakeholder their interests are given in key words. In addition the potential impact on the project is qualified as positive (+), negative (-) or unknown (+/-). In column four the relative priorities of the stakeholders on which this sanitation project focuses are represented with a number. The lower the number the more priority should be given to that particular stakeholder in order to reach the most appropriate sanitation in Mohlaletse village. In the last column the ways in which each stakeholder could influence the success of the project is labelled, using key words.

Stakeholder	**Interests**	**Potential project impact**	**Relative priorities of interest**	**influence, power**
Primary stakeholders				
Households Mohlaletse village	-Healthy solution -Affordable solution -Sustainable solution -Status	+ + + +/-	=1	-acceptance facilities -land ownership
Trainees MYSP	-Future job -Education	+ +	=1	-labour supply -dependant on MYSP
Secondary stakeholders				
Governmental				
National government Department of Water Affairs and Forestry (DWAF	-White Paper Basic Household Sanitation, 2001: Basic sanitation poorest people -Employment creation -Other policies -Related to Umsobomvu	+/- + +/- +	6	- making a general policy that guides lower governmental institutions
Northern Province Government	-Improving sanitation -Employment creation -Other policies	+ + +/-	5	-policy should guide municipal government
Fetakgomo Municipality	-Improving sanitation -Employment creation -Other policies	+ + +/-	=3	-strategic position -money
Marota – Mohlaletse Development Forum	-Improving sanitation -Employment creation -Priorities location	+ +	=3	-strategic position
Non governmental organisations (NGO's)				
Umsobomvu Youth Fund	-Improvement youth –skills, job opportunities	+	4	- financial resources
Joint Enrichment Project	-Educate people	+	=8	-expert knowledge
Project Literacy	-Improving literacy	+	=8	-expert knowledge
Research Centre for Employment Creation in Construction (WORK)	-Institutional learning -Employment creation	+ +	-	-expert knowledge
Labour Intensive Training	-Employment creation	+	-	-strategic

and Engineering (LITE)	-Realising quality construction -Prove project to be success	+ +		position -expert knowledge

Private sector organisations				
Employment Intensive Engineering Consultants (EIEC)	-Institutional learning -Employment creation	+ +	-	-specialist knowledge
James Croswell Associates	-Employment creation	+	-	-specialist knowledge - Most profit comes from expensive designs
Community based contractors	-Work, profit, experience -Use of locally available materials	+ +/-	2	- strategic resources

External stakeholders				
Paramount Chief of Sekhukhuneland	-Development area -Good relations with Donaldson Trust	+ +	=7	- social influence
The Church	-Support community -Keep up good relations with LITE	+/- +	=7	-Social and religious influence -Good relations with LITE
Mvula trust	-Improve community sanitation facilities	+	=8	-expert knowledge
Mister Donaldson	-Support community	+	9	-social influence

8 Techniques for sanitation in developing countries

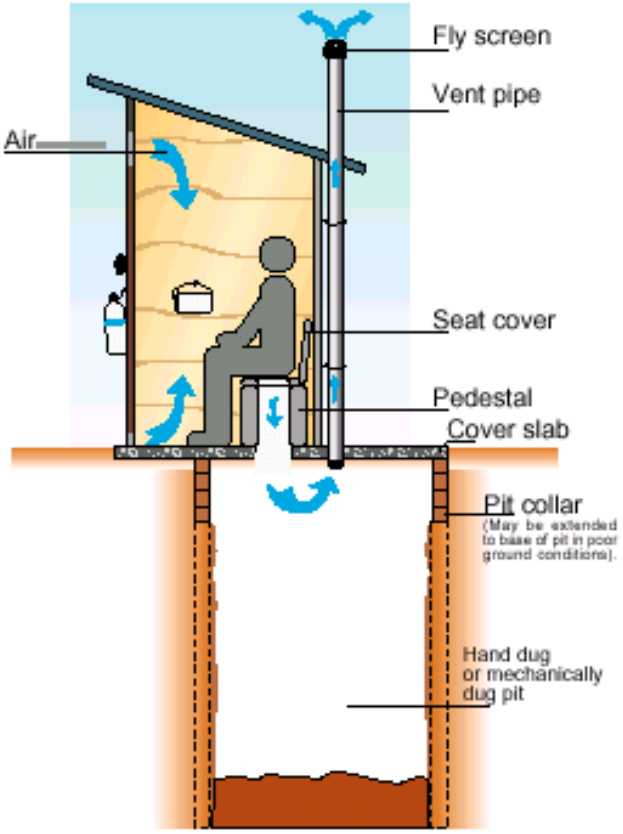
In the table below sanitation systems that are widely used in developing countries are given.

Dry on-site facilities	***Wet on-site facilities***
► Simple Pit Latrine / unimproved pit toilet ► Ventilated improved pit latrine (VIP) ► Ventilated Improved Double Pit (VIDP) ► Chemical toilet ► Urine diversion toilet (UD)	► Pour-Flush Latrine ► Aqua-privy[2] ► Septic Tank[2] ► Septic Tank for Excreta Reuse ► Biogas Digester ► Excreta-Fed Fish Pond
Cartage (off-site treatment)	***Sewerage (off-site treatment)***
► Latrine with Vault (bucket toilet) ► Conservancy tank (Pour-Flush and removal by tanker)	► Conventional Sewerage ► Simplified Sewerage / Shallow sewerage ► Settled sewerage / small-bore sewerage ► Covered storm water drains

[2] The aqua-privy and septic tank can be connected to on-site 'treatment systems'. This can be a seepage Pit / Soak away or a drain field.

9 Technical options: Principles of operation

In this appendix, the principles of operation of all the sanitation systems that that were analysed are described. In addition, the estimated costs of the different systems are given. All the information in this appendix originates from DWAF, 2001 and comments of Richard Holden (Holden, 2002).



Dry on site systems

Ventilated Improved Pit latrine VIP

Principles of operation

Waste drops into the pit where organic material decomposes and liquids percolate into the surrounding soil. Continuous airflow through the top-structure and above the vent pipe removes smells and vents gases to the atmosphere. A darkened interior is maintained causing insects entering the pit to be attracted towards the light at the top of the vent pipe and trapped by the fly screen. A separate hand washing facility is required.

Left: Appendix figure 6: *principles of operation of a VIP*

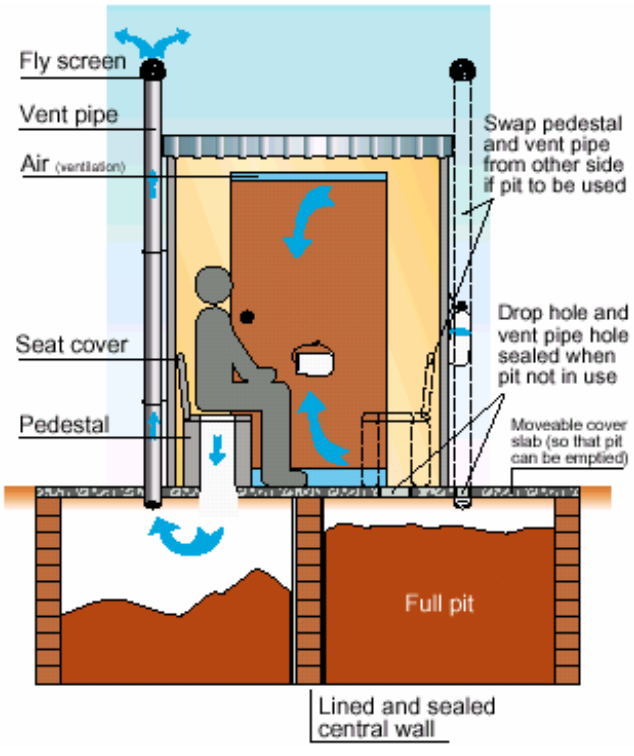
Down: Appendix figure 7: *principles of operation of a VIDP*

Ventilated Improved Double Pit latrine (VIDP)

Principles of operation

As for the VIP toilet. One pit is used until filled to within about half a metre of the top. The defecation and vent pipe holes are then completely sealed and the other pit used. The contents of the first pit are dug out after a period of at least two years, once the contents have become less harmful.

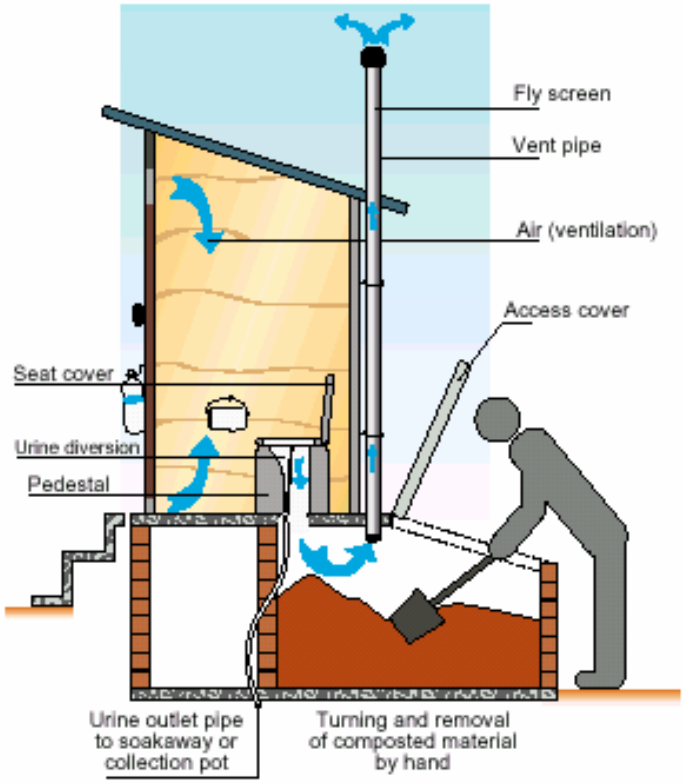
The pits should be underground for a depth of between 0,50-0,80 m to allow manual emptying. For the same reason they should not be above the ground level for more than 0,50 m (Richard Holden)



Urine Diversion toilet (UD)

Principles of operation

Waste is deposited in the chamber and dry absorbent organic material, such as wood ash, straw or vegetable matter is added after each use to deodorise decomposing faeces and/or control moisture and facilitate biological breakdown (composting). Urine may be separated / diverted through use of specially adapted pedestals. This may be collected and used as a fertiliser. In desiccation systems, ventilation encourages the evaporation of moisture.



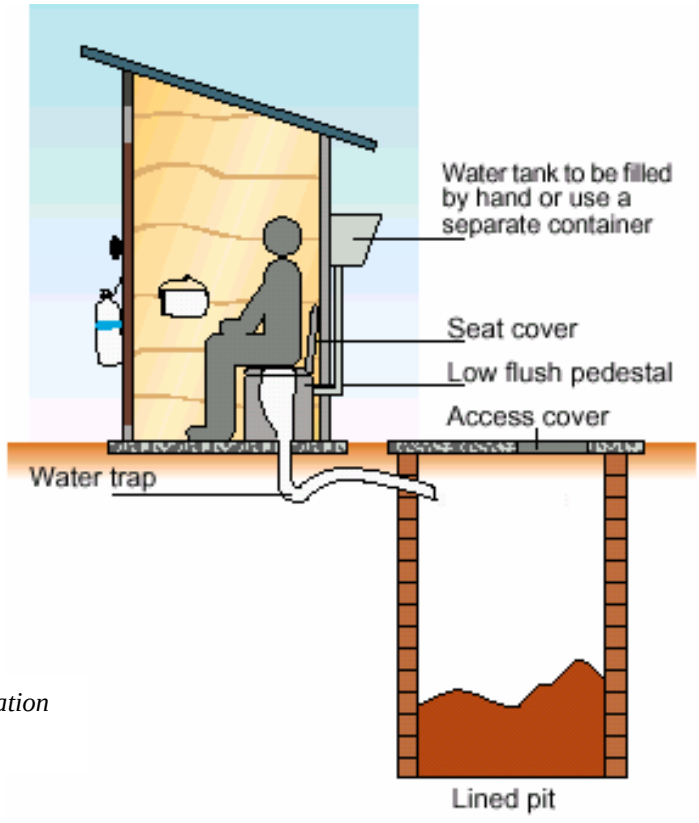
Appendix figure 8: *Principles of operation of a UD*

Wet on site systems

Pour-flush toilet

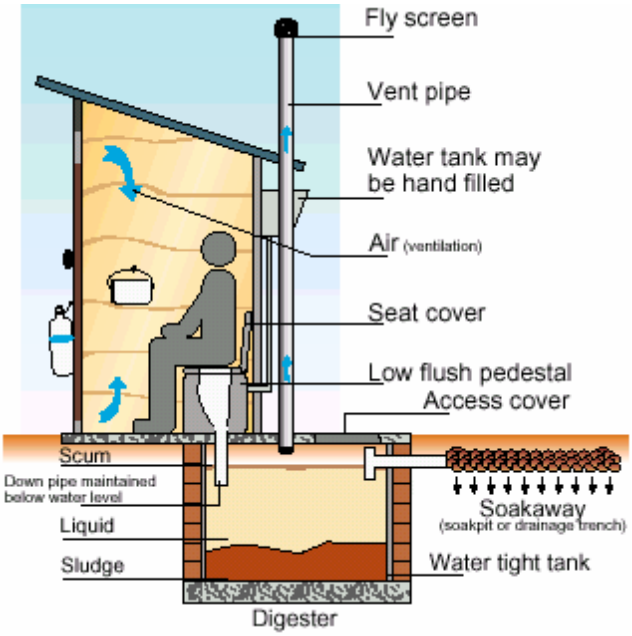
Principles of operation

After defecation, the pan requires flushing with a few litres of water. The water retained in the pan provides a seal against smell, flies and mosquitoes.



Appendix figure 9: *Principles of operation of a Pour-flush toilet*

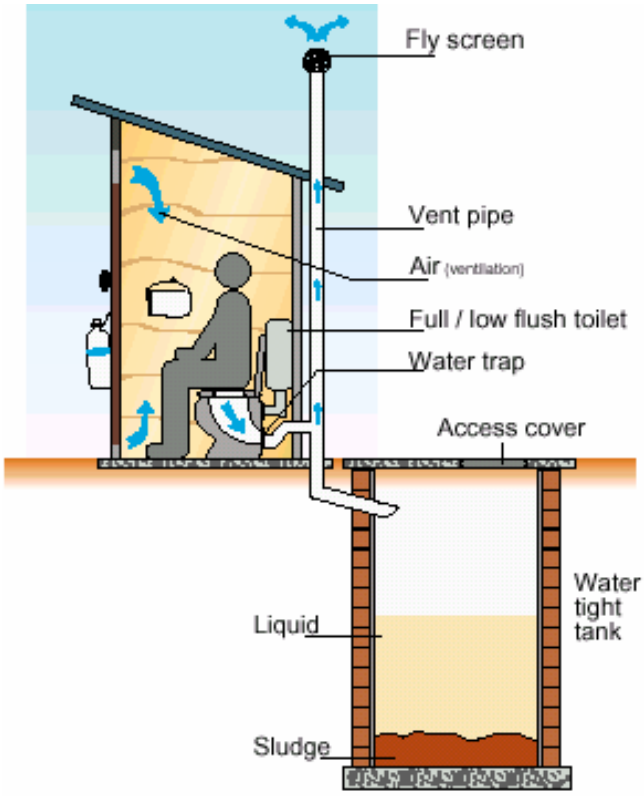
Aqua-privy and soak-away
Principles of operation
After defecation, the pan requires flushing with a few litres of water. An aqua-privy requires the addition of water to keep the end of the chute submerged. Containment of the waste may vary from a sealed container to a solids collection system and effluent soak-away.



Appendix figure 10: *Principles of operation of an Aqua-privy and soak-away.*

Cartage systems

Conservancy tank
Principles of operation
Waste is flushed into the tank where it is contained in isolation from the surrounding environment before removal by tanker for treatment.



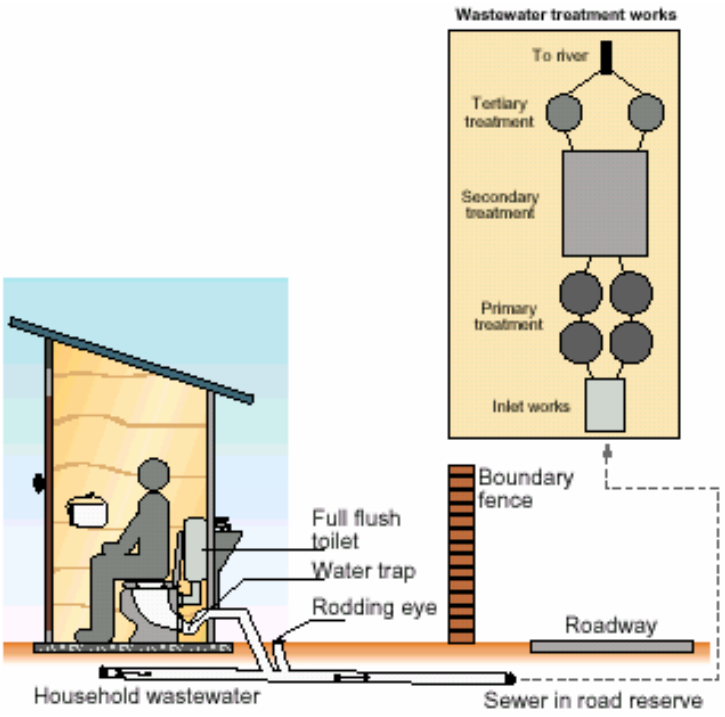
Appendix figure 11: *Principles of operation of a conservancy tank.*

Sewerage systems

Full bore waterborne sewerage

Principles of operation

Waste from the toilet, and possibly domestic wastewater, is flushed using significant volumes of water into the sewer system for removal to a treatment facility. There are several types of such facilities and these treat effluent to high standards prior to discharge into the aquatic environment.



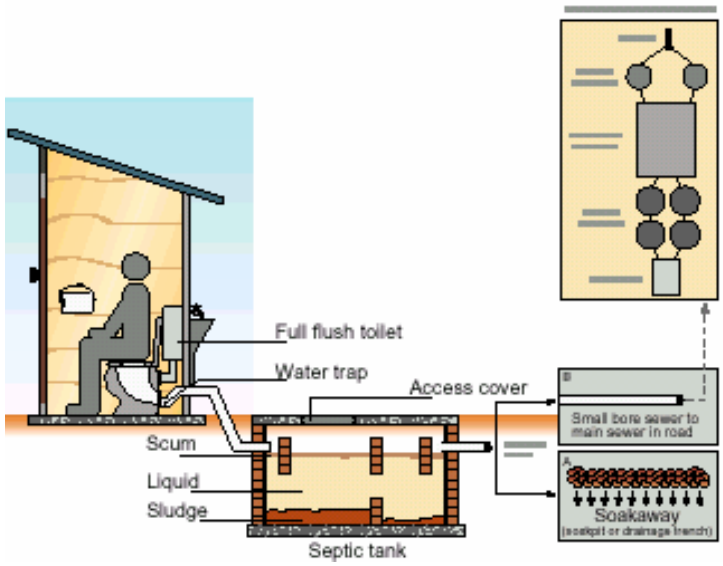
Appendix figure 12: *Principles of operation of full bore waterborne sewerage.*

Septic tank and soak-away or small bore solid-free sewer

P*rinciples of operation*

Septic tank and soak-away

Waste from the toilet, and generally domestic wastewater, is flushed into the settling chamber where it is retained for at least 24hrs to allow settlement and biological digestion. Partially treated liquids then pass out of the tank and into the subsoil drainage / soak-away system. Digested sludge gradually builds up in the tank and requires eventual removal by tanker.



Appendix figure 13: *Principles of operation of a Septic tank and soak-away or small bore solid-free sewer.*

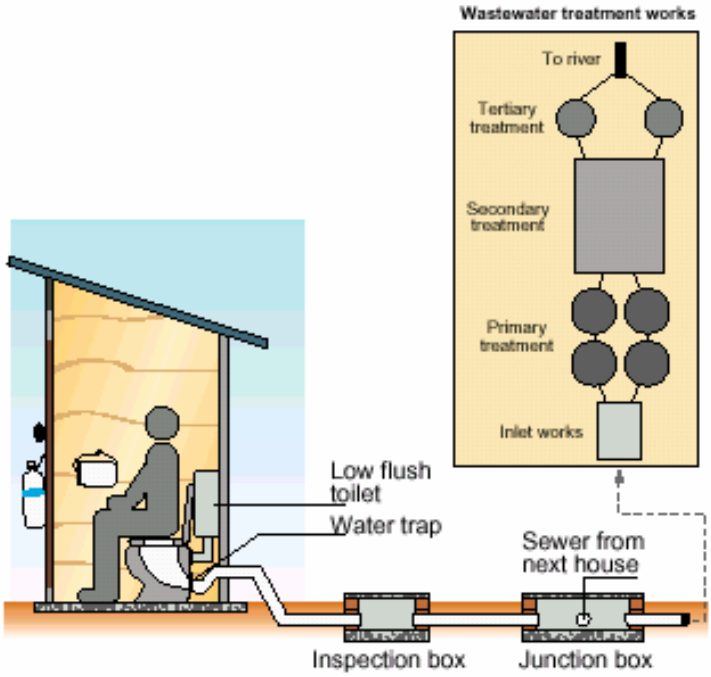
Small bore solid-free sewer

As for the septic tank and soak-away except that the liquid effluent is conveyed by a system of small-diameter pipes to a communal treatment point (which may be off-site treatment works reached either via existing sewerage or by tanker).

Shallow sewerage

Principles of operation

Waste from the toilet and possibly domestic wastewater, but at much lower volumes than for conventional sewerage, is flushed into the on-site sewerage system and progressively washed down to either a dedicated treatment facility or into street sewers and then on o a major treatment works.



Appendix figure 14: *Principles of operation of shallow sewerage.*

Different pans for flushing

A conventional toilet pan is an example of a water-seal appliance, but it requires between 6 and 8 litres per flush. Special pans have been developed that require only 3 litres per flush.

Various tipping-tray designs are also available with flush requirements varying from 0,75 to 2 litres depending on the design. These appliances have a shallow pan or tray that holds the water necessary for the seal. After use tipping it, allowing the waste matter to fall into the pit below, clears the tray. Thus the water is used solely for maintaining the seal, not for clearing the pan.

Pour-flush pans can also be used to maintain a water seal. These pans are flushed by hand using a bucket, and generally require about 2 litres per flush. The most serious disadvantages of this appliance are that the effectiveness of the flush depends on the human element, which varies greatly, and that there is no control over the amount of water used per flush.

(CSIR, 1991 and DWAF, 2001)

10 Groundwater pollution On-site sanitation

"The concern of on-site-induced contamination of groundwater is countered by a concern that the risks of groundwater pollution are overestimated (DWAF, 1997). Except perhaps in the most unfavourable hydro geological conditions, the groundwater pollution risk associated with low cost sanitation measures is not such as to warrant the abandonment of such activities" (Jackson, 1994).

In 1991, the South African Division of Building technology, CSIR, published 'Guidelines for the provision of engineering services and amenities in residential township development. In the part on sanitation the following passage was stated: "It is possible (but unlikely) that groundwater can be contaminated by a sanitation system, therefore the risk should be assessed or the groundwater periodically monitored, particularly where this water is to be used to human consumption. The soil around a pit latrine or subsurface drain provides a natural purification zone and tests both in South Africa and in other parts of Africa indicate that on-site sanitation does not pose a serious threat. Generally, the susceptibility of a water source to pollution decreases quite sharply with increasing distance and the depth from the source of pollution, except in areas with fissured rock, limestone, very coarse soil or other highly permeable soils."

Soak-aways attached to on-site sanitation systems should, wherever possible, be located downstream of drinking water supplies and the following guidelines for distances should be adopted. A soak-away should be 7,5 m from the drinking water source if the highest seasonal water table is more than 5 m below the bottom surface of the pit or soak-away. It should be 15 meters from the water source if the highest seasonal water table is 1-5 m below the bottom surface of the pit or soak-away. It should be 30 meters from the water source if the highest seasonal water table is less than 1 m below the bottom surface of the pit or soak-away. In areas that have fissured rock, limestone or very coarse soil there is no safe distance from a source of drinking water.

If the source of pollution extends below the ground water table, there will be a lateral movement of the water into and out of the pit (Shabalala, 1999). However, the organic pollution is not expected to travel more than about ten meters when the ground water velocity is less than 2.5 m a day (Shabalala, 1999). Wells should always be placed upstream in the ground water flow from a privy. When this is not possible, the distance should be at least 15 meters. In that case, there is no danger of pollution with coliform organisms (Shabalala, 1999). The risk of nitrogen or bacteria reaching the groundwater is increased if grey water is also disposed in the latrine (DWAF, 1997).

If the polluting source does not extend the ground water table different rules of thumb can be applied. Data exist showing that bacterial and viral levels generally decrease to background levels within 1 to 3 meters of movement in the unsaturated zone (Lewis et al., 1980). Other authors recommend unsaturated zones up to 10 meters. In porous soils, organisms like coliforms and the typhoid organisms are washed down for about 1.2 meters. In less porous soils like the soil in Mohlaletse organisms are washed down less far (Shabalala, 1999).

"Unfortunately there is a lack of work done on proving the impact on groundwater quality and qualifying the controls that influence contamination that occurs. The quantification of the threat posed by various sanitation systems to groundwater quality in South Africa is hence practically impossible" (DWAF, 1997).

The South African department for Water Affairs and Forestry uses a table that can be used for an indication on the pollution that comes along with the use of on-site sanitation systems. Two factors are used to quantify the threat to the groundwater system:

- ► The threat posed by the sanitation system.
- ► The potential of the unsaturated zone to attenuate contaminants before reaching the groundwater. The thickness of the unsaturated zone is not included here.

Comment: the potential of the unsaturated layer should be based on layer thickness *and* soil type (Holden, van Ryneveld, 2002).

DWAF Table: Risk of pollution on-site sanitation

Assessment of risk												
	Pollution load											
Unsaturated zone conditions	Settlement size < 500 inhabitants			Settlement size 500 - 1000 inhabitants			Settlement size 1000 - 5000 inhabitants			Settlement size > 5000 inhabitants		
	< 10 h/ha	10-50 h /ha	>50 h/ha	< 10 h/ha	10-50 h /ha	>50 h/ha	< 10 h/ha	10-50 h /ha	>50 h/ha	< 10 h/ha	10-50 h /ha	>50 h/ha
Clay	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Pos
Massive Shales	Low	Low	Low	Low	Low	Low	Low	Low	Pos	Low	Pos	Pos
Solid granites	Low	Low	Low	Low	Low	Low	Low	Pos	Pos	Low	Pos	Pos
Silt	Low	Low	Low	Low	Low	Pos	Low	Pos	Pos	Pos	Pos	Lik
Sandy loam	Low	Low	Pos	Low	Pos	Pos	Pos	Pos	Lik	**Pos**	Lik	Lik
Bedded shales	Low	Low	Pos	Low	Pos	Pos	Pos	Pos	Lik	Pos	Lik	Lik
Weathered or fractured granites	Low	Low	Pos	Low	Pos	Lik	Pos	Lik	Lik	Lik	Lik	Lik
Fractured/weathered sandstones	Low	Pos	Lik	Pos	Lik	Lik	Lik	Lik	Lik	Lik	Lik	Lik
Cavernous limestones / calcretes	Low	Pos	Lik	Pos	Lik	Lik	Lik	Lik	Lik	Lik	Lik	Lik
Sand and gravel	Pos	Lik	Lik	Lik	Lik	Lik	Lik	Lik	Lik	Lik	Lik	Lik

Profile Mohlatetse village:
Settlement size = 17.325 >5.000
2-4 houses per hectare < 10 houses per hectare.
Soils are mainly sandy loam.

For this profile the DWAF table indicates that that there is a possible risk of groundwater contamination. When looking at this profile, one can see that the amount of houses per hectare is much lower than the maximum within this profile. Combined with the thickness of the unsaturated zone that exceeds the tolerated minimum thickness by 12 (15 – 3) meters, the risk can be considered as low (Holden, 2002).

Conclusions

- ► Privy pits and bored-hole latrines should not penetrate into the groundwater table. The Department of Water Affairs and Forestry recommends the unsaturated zone should be at least 10 meters (DWAF, 1997)
- ► Occasional rises of the groundwater table, caused by heavy rainfall, into pits are of no significance. Much of the pollution will probably be held in the capillary water as the groundwater level falls again (Shabalala, 1999).
- ► Especially for dry on-site sanitation systems no contamination of the ground water in Mohlaletse village is expected.

11 Skills trainees MYSP and Construction Materials

Skills trainees MYSP

The Mohlaletse Youth Service Programme intends to tech the trainees to gather the following skills:

- Basic setting out
- Clearing of work site
- Detailed setting out
- Excavation
- For buildings: concrete foundations, wall masonry, floors, door and window frames, walls, roof, services, plastering, painting, cleaning, finishing off.
- For pipelines: bedding materials, pipe laying and jointing, valves and fittings and/or manholes, selected backfill, testing, general backfill, clean up.

(Taylor Parkins, 2002)

Prices materials

Most prices are given two times. The prices are gathered from two shops. Thete's shop and Letladi' shop are used by different groups of people. Most customers of Thete's shop support the acting king K.K. Sekhukhune. Most customers of Letladi's shop are opponents to the traditional leader.

Pipes (Pietersburg):
110 R72,90 6 m
50 R48,30 6m

Cement
50 kg R36,65 (both Thete shop and Letladi shop)

Wooden poles

7 feet	R19,50 (Letladi)	R21,24 (Thete)
8 feet	R21,95 (Letladi)	R24,95 (Thete)
10 feet	R28,50 (Letladi)	

VIP toilet: R472,50, no pipe: R456 (Jumbo) (Thete)
VIP toilet: R530, no pipe: R513 (Jumbo) (Letladi)

Mud bricks 0,15*0,15*0,30 R2,50 (Thete)
Mud bricks 0,15*0,15*0,30 R1,50 local development project Mr Gorvin Pasha.

Washing hand tap: R 0,50 (Mvula Trust)

12 Valuable contacts

Sanitation procedures and experience with sanitation programmes:
Richard Holden
National Sanitation Operations Manager, Mvula Trust
PO Box 32351, BRAAMFONTEIN, 2017
Tel (011) 403 3425/ Cell 082 451 4796
Fax.(011) 403 1260

Water supply project for the Fetakgomo municipality:
Jacques Kruger
Eksteen, van der Walt, Nissen
Schoemanstraat 30, Polokwane

Community based concrete pan production:
Wicus Diedericks
Cemforce
Cell 082 805 5667

13 Questionnaires

Two questionnaires were held in Mohlaletse village. For the first one 59 people, who are all part of different households, participated. All the participants are part of the MYSP training programme. They come from different sections in Mohlaletse. The trainees are not evenly spread over the village and some of them live just outside the village.

Questionnaire on sanitation in Mohlaletse 1

Later on this year a start will be made with the construction of sanitation facilities in Mohlaletse. I am researching what technique would be appropriate. Therefore I need information from the people of Mohlaletse. To meet the needs of the people in Mohlaletse I need to know your answers to the following questions. I appreciate your cooperation.

Please answer the questions with ✓ on the 0.

Put your comments in English please.

1. What is your name? Leina lagago o mang?

……

2. In which region of Mohlaletse do you live? O dula motsaneng ofe mo Mohlaletse?

0 Debeila.
0 Gaphasha.
0 Lerajane.
0 Malaeneng.
0 Matsimela
0 Moshate
0 Nchabeleng
0 Outside Mohlaletse. Ka ntle ga Mohlaletse
Please specify, Hlatholla..……

……

3. How many members are in your household? Lebaba kae ka lapeng?

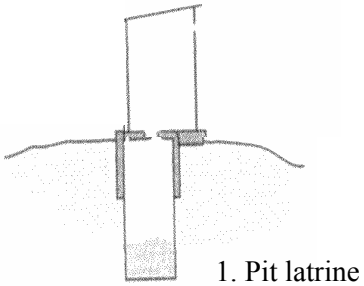
……

4. Where do you collect your water? Lehwetsa meetse kae?

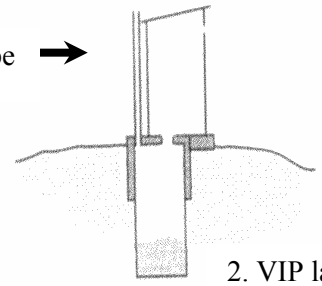
0 River. Nokeng
0 Pump / bore hole . Pomping
0 Tap. Thepeng
0 Somewhere else. Go gongwe ntle le tse tsa ka godimo.
……

5. What do you use for sanitation? O somisa eng go i thoma?

0 Toilet in house. Tshwamare ya ka Ntlong
0 Toilet outside house. Please specify: pit latrine (1), VIP latrine (2)
Tshwamare ya ka ntle ga ntlo. Hlatholla: Ya go ikagela (1), Ya go rekwa.



1. Pit latrine



2. VIP latrine

6. Do you use water for sanitation (flushing)? A o somisa meetse go tlosa tshila?

0 Yes. Ee
0 No. Aowa

7. Are you happy with the sanitation at your home? A o a kgotsofala ka kelela tshila ya ka mo gae?

0 Yes. Ee
0 No. Aowa . Please specify. Hlatholla……..

8. Do you have any problems with your toilet / sanitation (broken, smell, overflow)? A e kaba lena le bothata ka tshwamare/kelela ya lena (e robegile, E nkga, E shwahlisa

0 Yes. Ee. Please specify, Hlatholla ……
0 No. Aowa

9. Have you ever used other sanitation at your home? Ale kile la somisa kelela ya mohuta o mongwe ka mo gae la lena?

0 Yes. Ee.Please specify,
Hlatholla……
0 No. Aowa

Questionnaire on sanitation in Mohlaletse 2

Later on this year a start will be made with the construction of sanitation facilities in Mohlaletse. I am researching what technique would be appropriate. Therefore I need information from the people of Mohlaletse. To meet the needs of the people in Mohlaletse I need to know your answers to the following questions. I appreciate your cooperation.

Please answer the questions with on ✓ the 0.

Put your comments in English please.

Questions about the current situation

1. What is your name? Leina lagago o mang?

……..

2. In which region of Mohlaletse do you live? O dula motsaneng ofe mo Mohlaletse?

0	Debeila.	0	Matsimela
0	Gaphasha.	0	Moshate
0	Lerajane.	0	Nchabeleng
0	Malaeneng.	0	Outside Mohlaletse. Ka ntle ga Mohlaletse Please specify, Hlatholla…..

…….

3. How many members are in your household? Lebaba kae ka lapeng?

…….

4. Where do you collect your water? Lehwetsa meetse kae?

0 River. Nokeng
0 Pump / bore hole . Pomping
0 Tap. Thepeng
0 Somewhere else. Go gongwe ntle le tse tsa ka godimo.

…….

5. What do you use for sanitation? O somisa eng go i thoma?

0 Toilet in house. Tshwamare ya ka Ntlong
0 Toilet outside house. Please specify: pit latrine (1), VIP latrine (2)
Tshwamare ya ka ntle ga ntlo. Hlatholla: Ya go ikagela (1), Ya go rekwa.

6. What do you use when you are at the toilet? O somisa eng geole ka Tshwamareng?

0 Newspaper. Kuranta
0 Toilet paper. Toilet paper
0 Other. Se sengwe

Questions about new sanitation.
Diputsiso mabapi le kelela tshila e mpsha.

7. What do you prefer when you get a new toilet? O duma eng ge o hwetsa tshwamare empsha?

0 Toilet inside the house. Tshwamare ya ka gare ntlo.
0 Toilets outside the house. Tshwamare ya ka ntle ga ntlo
Explain. Hlalosa ……

8. What do you prefer? O duma eng?

0 Using a flushing toilet (and collecting water yourself for flushing) Go somisa tshwamare ya go flasha (wa e kgela meetse ka bo wene wa flasha)
0 Using a VIP (no water). Go somisa tshwamare ya mokoti (ya go se be le meetse)

9. Do you consider it a problem if your toilet is on the roadside of your households plot? A o bona ele bothata ge tshwamare ya gago ele mo kgauswi le tsela ya motse wag gago?

0 Yes, Why? Ee, Lebaka?……
0 No problem. Gago bothata

10. Are you willing to pay extra money (every year) for a flushing toilet instead of a VIP? A o ekemiseditse go lefela tshwamare e kaone ya go flasha (gwaga ka ngwaga) ya go phala ya mokoti?

0 Yes. Please explain. Ee, hle hlatholla……...
0 No. Aowa

11. What do you think about sharing a toilet with other households? A o ekwa bjang go hlakanela tshwamare le ba malapa a mangwe?

0 No problem. Ga go bothata.
0 It would be a problem. Why? E tlo ba bothata, lebaka?.....

If sharing a toilet means that you can use a flushing toilet instead of a pit latrine? A go hlakanela tshwamare gora gore, a oka kgona go somisa ya go flasha legatong la ya go ikagela?

0 No problem. Ga go bothata.
0 It is a problem. Ke bothata.
Comment: Dikgopolo.

12. Do you know that you can use human waste as fertilizer, to grow crops? A o a tseba gore matswela ntle (ditshila) a ka somiswa bjale ka manyora, go bjala dibjalo?

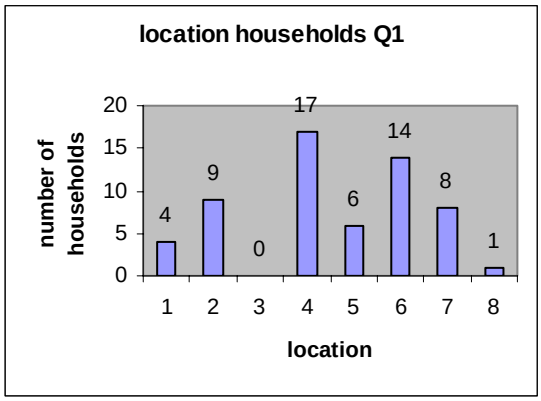
0 Yes. What do you think of that? Ee. Ao nagana eng?……
0 No. Aowa.

General comment. Di kgopolo ka botlalo…….……...
……..

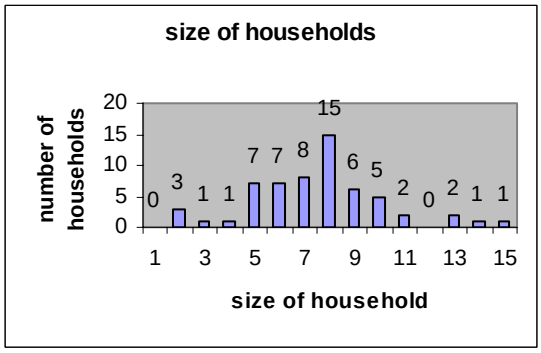
Thank you very much for answering the questions!!!!!
Re leboga kudu ge o fetotse dipotsiso !!!!

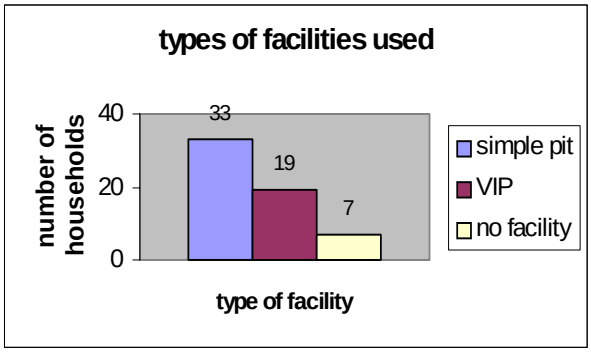
14 Results questionnaires

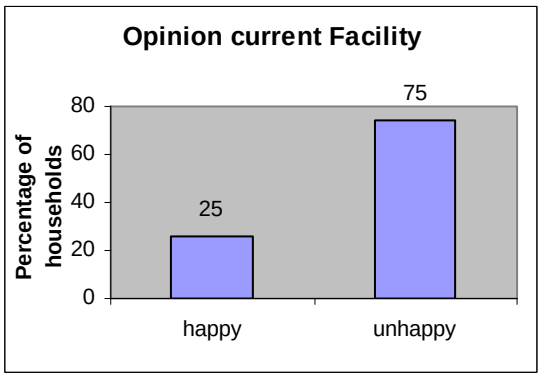
Results questionnaire 1

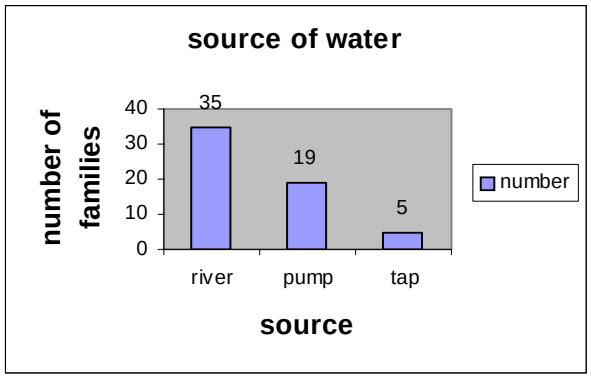


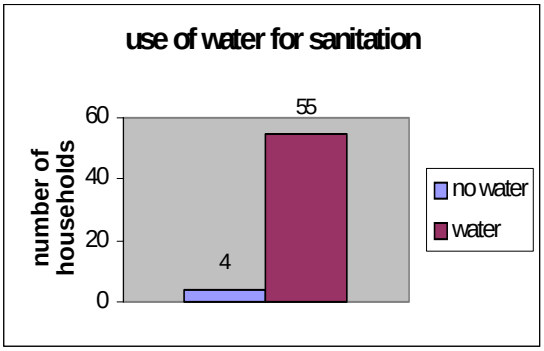
1. Debeila.
2. Gaphasha.
3. Lerajane
4. Malaeneng
5. Matsimela
6. Moshate
7. Nchabeleng
8. Outside Mohlaletse village











Results of questionnaire 2

Water source	**river**	**pump**	**tap**	**other**
%	60	33	5	2
Location of toilet	**Inside house**	**Outside house**	**No toilet**	
%	3	81	16	
Material used for anal cleansing	**newspaper**	**stones**	**Toilet paper**	
%	74	21	5	
Prefer toilet in/outside house	**inside**	**Outside**		
%	44	56		
	% Yes	**% No**		
Prefer flushing	46	54		
Problem with toilet on roadside	68	32		
Will you pay extra money	33	66		
Are you willing to share	19	81		
Sharing if better toilet	38	62		
Knowledge about compost	62	38		

Comments questions about new sanitation.

7. What do you prefer when you get a new toilet?

Comments (most mentioned first):

Outside:
We have no money
We have no water
We do not want to carry water
We do not have sewerage

Inside:
We save time
We like comfort
We do not have to be afraid for criminals

9. Do you consider it a problem if your toilet is on the roadside of your households plot?

Comments (most mentioned first):

Problem:
Bad smell / I do not want others to close their nose when passing my toilet
People laugh when they see me
Too far when having stomach problems
At night I cannot go, I am afraid

10. Are you willing to pay extra money (every year) for a flushing toilet instead of a VIP?

Comments (most mentioned first):

Yes:
Extra money to avoid smell
I already do
No flies and mosquitoes when flushing

No:
I have no money
I prefer to spend money on other things

11. What do you think about sharing a toilet with other households?
Comments (most mentioned first):

Problem:
Neighbours will not clean it (Almost everybody commended this)
Privacy
Waiting / queuing

If sharing a toilet means that you can use a flushing toilet instead of a pit latrine?
Comments (most mentioned first):

Problem:
No money
No water
The neighbours will not pay / one household has more money to spend than others
No good relationship neighbours.
The neighbours will not collect water for flushing

12. Do you know that you can use human waste as fertilizer, to grow crops?
Comments (most mentioned first):

Yes:
Good for crops
When they are dry they do not smell
It is a cheap alternative for other fertilizers
I already use it

General comments

- We don't want flushing because we need the water.
- How can you improve sanitation when we do not have water.
- Everything would be fine, if we only would like to share the same toilet
- Our village is not ready for flushing toilets because there is not enough water yet.
- Being unemployed and having no money, we would be overjoyed if toilets will be built for us.

15 Strengths and weaknesses sanitation systems

Kalbermatten, 1982a and Loetscher, 1999 use several criteria of which the following are most important to this research:

- ► Rural application
- ► Construction costs
- ► Operating costs
- ► Self help potential (community based maintenance)
- ► Water required (amount)

In the next table, the techniques are confronted with five general important characteristics.

	Rural application	*Construction costs*	*Operating costs*	*Self help potential*	*Water required*
Dry on-site	Suitable	**L**	**L**	**H**	**N**
Wet on-site	Suitable	**L***	**L***	Dep on tech.	**Y**
Cartage	Not suitable	**M**	**H**	**H**	Dep on tech.
Sewerage	Not suitable	**H**	**H**	**L**	**Y**

*Septic tank: H,
L = Low, M = Medium, H = High, Y = Yes, N = No

Matrix Mvula Trust

The Mvula Trust uses a matrix that is made using experience in South Africa. This matrix does not include cartage options, because the Trust considers this option not appropriate in any case (Holden, 2002). It includes two options for dry on-site sanitation. Part of this matrix is shown below.

	Responsibility	**Waterborne sewerage**	**On-site wet**	**VIP**	**Urine diversion**
Water required		Reliable supply	Reliable supply	No	No
Inside house		Yes	Yes	No	Yes
Capital requirement	Household	R5,000	R5,000-7,000	1,000-2,500	1,000-2,500
	Municipality	R5,000	500	0-500	0-200
Maintenance requirement	Household	-Problems on-site -Pay municipality	-Problems on-site -Emptying	-Fly screen -Vent pipe -Emptying -Move	-Fly screen -Vent pipe -Urine pipe -Manual emptying -Bulking agent
	Municipality	-Main sewer blockages -Maintain works	-Treatment of sludge -Maintain tanker	-Education -Treatment of sludge	-Education -Treatment of sludge
Monthly maintenance costs		R30-100 Not incl. flush. water	R20-R50 Not incl. flush. water	R10-20	R0-5
Who is affected in case of failure		Widespread environmental pollution	Household	Household + community as a whole	Household

A detailed overview of the strengths and weaknesses of the 9 governmental approved techniques for sanitation are given in Appendix 16.

16 SWOT alternative sanitation systems

These strengths and weaknesses are partly obtained from Loetscher (Loetscher, 1999) and the White paper on basic household sanitation of the Department of Water Affairs and Forestry (DWAF, 2001). Strengths, weaknesses, threats and opportunities are placed in order of relative importance, beginning with the most important one. For this SWOT Analysis information is used from DWAF, a questionnaire among 59 households and interviews with David Llewellyn, Philemon Sekwati and Jacques Kruger.

SWOT Dry on –site techniques

SWOT matrix VIP

Strengths:	***Weaknesses:***
► Simple construction ► VIP is odourless ► Not expensive ► No water needed for flushing ► All types of anal cleansing materials may be used	► Does not accept domestic wastewater. ► Danger of groundwater contamination (drinking water mainly from river and new supply) ► Cannot be placed inside house. ► Excreta can be seen through the hole in the squatting plate ► When pit is full, a new one/replacement is needed
Opportunities	***Threats***
► The people have accepted the VIP ► The national government approves the VIP as basic low cost technique. Subsidies ► Materials all locally available.	► Water supply project makes water use increase: overflow / groundwater pollution when household waste water is put in ► Population growth: groundwater contamination
General constraints	
► Requires permeable soils. According to Shabalala the soils in Mohlaletse village are ok (Shabalala, 1999) ► Not suitable in areas with frequent flooding. According to villagers there is no frequent flooding in Mohlaletse village. ► User education is needed ► Not suitable for very high population densities. Mohlaletse village is not and will not be densely populated (Kruger, Sekwati, 2002)	

SWOT matrix Ventilated Improved Double Pit (VIDP) toilet

Strengths	***Weaknesses***
► Simple construction ► No water needed for flushing ► All types of anal cleansing materials may be used ► Decomposed waste can be used as a soil conditioner. ► Pit does not have to be deep ► No smell ► Pit does not have to be deep	► Excreta can be seen through the hole in the squatting plate ► Danger of groundwater contamination ► Does not accept domestic wastewater. ► Not suitable for very high population densities ► Cannot be placed inside house.
Opportunities	***Threats***
► Subsidies might be available ► All materials locally available.	► Water supply project makes water use increase: water put into the pit makes it unhygienic ► There is a chance of resistance to the handling of the decomposed waste.
General constraints	

- ► Requires permeable soils
- ► Not suitable in areas with frequent flooding
- ► User education needed
- ► Suitable disposal site

Composting/urine diversion (UD) toilet

The composting / urine diversion toilet has the same strengths and weaknesses as the Ventilated Improved Double Pit (VIDP).

Additional weaknesses to the VIDP are:

- ► Dry absorbent organic material, such as wood ash, straw or vegetable matter has to be added after each use to deodorise
- ► Contents often become too wet, making the vault difficult and unhygienic to empty, as well as malodorous.
- ► The UD can be placed inside the house.
- ► No experience in South Africa. Bad experiences in Sweden (Hanæs, 1997).

Costs dry on-site techniques

	VIP	**VIDP**	**UD**
Capital costs	R600-R3000[3]	R2 500-R4 500[2]	R3 000-R4000[2]
Operating costs (year)	R60[4]	R20-70[5]	R35-R500[4]

SWOT wet on-site techniques

SWOT matrix Pour-flush toilet

Strengths	***Weaknesses***
► Rather simple construction ► High service level, flushing toilet ► Accepts small amounts of grey water ► No smell	► Danger of groundwater contamination ► Needs mechanical emptying of contained waste
Opportunities	***Threats***
► Water supply project: 60 litres per capita per day ► People like flush-toilets / convenience	► No on plot water connections on short term ► Costs of emptying can become an obstacle for emptying and therefore, proper operation
General constraints	
► Small amounts of water required ► High reliance on the soil environment in rendering the effluent harmless ► Not suitable for very high population densities. Mohlaletse village is not and will not be densely populated (Kruger, Sekwati, 2002)	

[3] depending on householder input and choice of materials.
[4] if emptied once every 5 years
[5] depending on local government involvement, householder willingness to handle waste and disposal options

SWOT matrix Aqua-privy / septic tank and soakaway

Strengths:	*Weaknesses:*
► Rather simple construction ► High service level, flushing toilet ► Accepts considerable amounts of grey water ► No smell	► Danger of groundwater contamination (less than pour-flush toilet) ► Needs mechanical emptying of contained waste (once every 10-20 years, Croswell and local plumber, 2002) ► Constructing and maintaining water tightness may prove difficult ► An aqua-privy requires the addition of water to keep the end of the chute submerged. ► Blockages can occur through use of inappropriate anal cleansing material
Opportunities	***Threats***
► Water supply project: 60 litres per capita per day ► People like flush-toilets	► No on plot water connections on short term ► Costs of emptying can become an obstacle for emptying and therefore, proper operation
General constraints	
► Requires a reliable household water connection ► High reliance on the soil environment in rendering the effluent harmless ► Soak-away system is particularly prone to failure in the long-term if detailed soil testing is not carried out. ► Not suitable for very high population densities	

Costs wet on-site techniques

	Pour-flush toilet	**Aqua-privy and soak-away**	**Septic tank and soak-away**
Capital costs	R2 000-R3 500[6]	R2 000-R3 500[5]	R7000-8500[5]
Operating costs (year)	R150-R300[7]	R150-R300[6]	R200-450 per emptying[6]

SWOT Cartage techniques

Strengths and weaknesses Pour-flush toilet with Conservancy tank

Strengths	***Weaknesses***
► Simple construction ► No groundwater pollution on plot ► Applicable in very high population densities	► Prone to odours and insect nuisance ► Accepts only small amounts of grey water ► Facilities needed for the collection and disposal off-site ► Needs frequent mechanical emptying of contained waste ► High institutional requirements
Opportunities	***Threats***
-	► Increasing water supply: faster fill-up ► If households have to pay the emptying themselves, malfunctioning can occur ► Different households have different fill-up rates
General constraints	
► Access required for night soil collection ► A pour flush toilet requires water	

[6] can increase where soils are not well suited to drainage
[7] where subsoil drainage is available.

Costs of Pour-flush toilet with Conservancy tank

	Pour-flush toilet with Conservancy tank
Capital costs	R2 000 - R5 000[8]
Operating costs (year)	R550[9]

SWOT Sewerage techniques

Full bore waterborne sewerage

Strengths	***Weaknesses***
► Convenience ► Feasible for very high population density ► Allows efficient treatment of collected sewage in a centralised location ► Isolated from the surrounding environment	► Expensive ► Skilled engineers and contractors are required for construction and maintenance ► Needs significant volume of flushing water. ► The health consequences of failure are devastating in comparison to on-site, dry sanitation
Opportunities	***Threats***
► Water supply project: 60 litres per capita per day ► People like flushing toilets	► Treatment works relative expensive for small scale project ► A common system requires common responsibility and (financial) response in case of failure
General constraints	
• Uses large quantities of water, uninterrupted household water connection necessary	

SWOT matrix Small bore solid-free sewer

Strengths	***Weaknesses***
► Convenience ► Feasible for high population density ► Allows efficient treatment of collected sewage in a centralised location ► Settled sewage can be used to upgrade septic tanks (are not in place so far) ► Isolated from the surrounding environment (of plots) ► Can be laid out in less formal and spatially irregular settlements than full bore waterborne sewerage. ► Because (incidental) blockages are most likely to occur on-plot, the responsibility can be addressed on household level.	► Expensive ► Skilled engineers and contractors are required for construction and maintenance ► Needs additional water to maintain water level ► Routine maintenance of pipe network is essential. ► Needs sludge treatment and disposal facilities.
Opportunities	***Threats***
► Water supply project: 60 litres per capita per day ► People like flushing toilets	► No septic tanks in place
General constraints	
► Uses large quantities of water, uninterrupted household water connection necessary	

[8] Depending on top structure and tank volume
[9] Assuming the tank is emptied, on average, 3 times per year

SWOT matrix Shallow sewerage

Strengths	***Weaknesses***
► Convenience ► Feasible for high population density ► Allows efficient treatment of collected sewage in a centralised location ► Isolated from the surrounding environment (of plots) ► Can be laid out in less formal and spatially irregular settlements than full bore waterborne sewerage.	► Expensive ► Skilled engineers and contractors are required for construction and maintenance ► Routine maintenance of pipe network essential. ► Needs sludge treatment and disposal facilities. ► Organised and effective operation and maintenance capability is required ► Significant user education and acceptance of shared management of the system is critical
Opportunities	***Threats***
► Water supply project: 60 litres per capita per day ► People like flushing toilets	► No septic tanks in place ► A common system requires common responsibility and (financial) response in case of failure
General constraints	
► Uses large quantities of water, uninterrupted household water connection necessary	

Costs sewerage systems

	full waterborne sewerage	**Small bore solid-free sewer[10]**	**Shallow sewerage**
Capital costs	R6 000-R7 000[11]	R7000-R8500	R2500-R3000
Operating costs (year)	R400-R800	R200-R450 per empt.	R300-R450[12]

[10] Costs are similar to those of the septic tank and soak-away detailed above if septic tank systems already in place, otherwise capital costs are much higher.
[11] without treatment works
[12] Drops to R 312 where residents are responsible for operation and maintenance of block (not bulk) sewers

17 Stakeholder participation

In this appendix a description of the preferable form of participation during the different phases of the project is given.

Identification

Inform
In the first phase of the project the local influential stakeholders (Paramount chief , Churches) have to be informed on the general ideas of the project. The households have to be informed about the alternative sanitation systems, to become able to make an informed choice.

The MYSP trainees have to know what the practical part of their training will be like and they have to be educated to be prepared for the tasks that they will be involved in further on in the training programme. Households and trainees overlap, as all trainees are members of households. This means that households can be informed trough the programme.

Consult
The preferences of the households should become clear. Information from the households can be obtained by interviews and showing them, or their representatives in the Marota Forum, examples.

The Fetakgomo municipality should be asked for their plans regarding water supply. The consultant working on a water supply program that covers Mohlaletse village is Eksteen, van der Walt, Nissen in Polokwane. Municipalities must seek to achieve at least 75 % coverage in villages within a few years (Mvula, 2002). According to the White paper the municipality is responsible for assisting households to provide their own sanitation. As part of this process it must make the community and households aware of the importance of sanitation and the implications it has for health. Municipalities must budget and source funding for sanitation improvement programmes. Sanitation business plans[13] should be developed for each project. Such business plans make it possible for project managers to get access to municipal subsidies.

The Mvula trust is an NGO with a lot of expertise in the field of sanitation. They are in close contact with companies specialised in community based engineering.

Partnership
Off course there should be appropriate communication among the partners of NetWORK and James Croswell Associates about objectives and strategies. Community-based contractors should have as big say in the ways of constructing and use of materials. A lot of valuable information is in their possession.

Control
The national government has stated a policy regarding basic household sanitation (white papers 1995, 2001). The project should fit within the policy of the national government and the Northern Province. The Fetakgomo municipality has the responsibility for realising a 75 percent coverage of Mohlaletse village. It has the ability to subsidise households with R900.

As the Paramount Chief is informed, his possible opinion should be respected. The Paramount Chief controls a large part of the public opinion, so he should be persuaded on the usefulness of the strategy.

[13] Richard Holden from Mvula Trust can give information on these Sanitation Business Plans and help developing such a plan.

Planning

Inform
The households should be informed on when the activities will start and be finished. The Fetakgomo municipality should know what is happening within its borders. Umsobomvu Youth Fund has to be informed on the labour created during the period of execution.

Consult
Household should be able to give their preferences on alternative facilities. This includes materials used for and location of their facility. Local contractors should be involved by agreeing upon their role and responsibility during construction (and maintenance)

Partnership
Off course there should be appropriate communication among the partners of NetWORK and James Croswell Associates about strategies and responsibilities. James Croswell associates is the most important stakeholder because of expert knowledge. Community based contractors should be involved.

Control
Network should actively persuade the plan and objectives to the community. Especially the municipality deserves attention. If there are problems, the paramount chief can give his, very much respected, opinion.

Implementation

Inform
The households, Umsobomvu and the municipality should be informed on the exact planning.

Consult
The households, trainees and the community-based contractors are implementing the planned activities under supervision LITE, which is part of NetWORK.

Partnership
The Network coalition is supervising the construction activities. LITE is executing the operational management, while working together with community based contractors.

Control
NetWORK should actively persuade the plan and objectives to the community. Evaluation is not described as this is beyond the scope of this research.

18 Checklist for VIPs and Urine Diversion Toilets

The Mvula trust works with the following checklist for the VIP and the UD. The answer to all the following questions should be yes. If the answer is no then modifications to the design are required.

Vent pipe

- ► Is the vent pipe 110 mm in diameter or greater?
- ► Does the vent pipe extend more than 500 mm above the roof?
- ► Is the vent pipe clear from the wind shadow of a building or tree?
- ► Is the vent pipe straight?
- ► Does the vent pipe have a fly screen on it?
- ► Is the vent pipe clear of the sides of the pit?
- ► Is the vent pipe free from obstructions?
- ► Are the seat of the toilet and the vent pipe the only openings into the pit?

Pedestal and Slab

- ► Is the size of the hole, through which the faeces fall, large enough to prevent fouling in most circumstances?
- ► Is the inside of pedestal flush with the hole in the slab so that faeces cannot catch on it?
- ► Is the drop hole free from reinforcing on which faeces can catch?
- ► Is the slab free from cracks through which insects can crawl?
- ► Is the slab sitting on well compacted ground or flush with the underlying brickwork to prevent entry of insects and water into the pit?

Ventilated Improved Pit Toilet

Is the pit dark through use of a toilet seat or a shaded top structure so that the light down the vent pipe is stronger than the light through the pedestal?

Urine Diversion Toilet

- ► Will the pit remain dry during heavy rain? A cap on the vent pipe might be required to prevent entry of water.
- ► Is there a bulking agent (ash, soil, compost etc.) to sprinkle on faces after use?
- ► Is the pit sealed to prevent access by insects?
- ► When the pits need emptying can they easily be accessed?