HEALTH - RELATED WATER QUALITY AND SURVEILLANCE MODEL FOR THE PEDDIE DISTRICT IN THE EASTERN CAPE

Report to the Water Research Commission
on the project
"Health-Related Water Quality and Surveillance Model
for the Peddie District in the Eastern Cape"

by

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EXECUTIVE SUMMARY

Rationale

South Africa, like most developing countries, is experiencing a rapid population growth, as well as rapid urbanization in and around the country. This accelerated population growth occurs in the impoverished socio-economic environment, with limited water resources and poor sanitation. An increase in diseases associated with poor living conditions often results. Among these, water-related and waterborne diseases play a major role.

As stipulated in the Water Supply and Sanitation Policy (1994), the "lack of basic services such as water supply and sanitation is the key symptom of poverty and underdevelopment". The provision of such services must be part of a coherent development strategy if it is to be successful.

The White Paper has urged that the way in which South Africa's limited water resources are used must also be part of such a development strategy. The creative management and use of water will also be vital to assure that the Reconstruction and Development Programme's objectives are met and that eradication of poverty and promoting sustainable and social development is realized.

The Eastern Cape Province, second poorest Province in South Africa, is faced with poor living conditions, which result in an increase in disease. Peddie district in the Eastern Cape, is a rural area, which lacks basic needs such as water supply and sanitation services, which are the key symptoms of underdevelopment. Peddie was observed to have limited unprotected water sources, which are also used by domestic animals. These conditions are associated with an increase in water-related diseases because of the poor water quality.

Objectives

This study was aimed at examining both microbial and physiochemical quality of water provided to the community of Peddie and comparing that to the health indices of the population.

The objectives were as follows:

- To determine the quality of water at the point of provision
- To examine the patterns of water usage - including the quantity - for farming, drinking, washing and other hygiene purposes, as well as identification of the treatment method of water by the end-user prior to use
- To develop, test and evaluate water surveillance techniques incorporating sanitary inspection and water quality monitoring
- To provide a scientific basis for prioritizing remedial action strategies which will protect the user from the risk of waterborne diseases.

Results

The pilot study reveals that faecal coliform pollution in the majority of water sources is widespread throughout the Peddie district. The study found the incidence of faecal pollution as follows: Rivers - 70 per cent; dams and pans - 48 percent; springs, wells and fountains - 80 per cent; and boreholes - 33 per cent.

The majority of communities are solely dependent on these as there are no other sources available. All the sources visited were categorized into classes –
Class 2 (conditionally accepted for potable use), Class 3 (unsuitable for potable use), and Class 4 (totally unsuitable for potable use). Domestic animals, especially pigs, throughout the Peddie district, were found to be sharing the same water sources as humans.

The study also found that a significant number of sources contained elevated iron concentrations in the water supplies. Few incidences of nitrate in boreholes and springs were detected. Notably, most of the water sources had elevated TDS concentrations, which made the water unpalatable. Sodium was the dominant cation, with chloride as the dominant anion. The pilot study also found that seasonal change did not affect the water quality significantly since only three (3) villages out of the thirteen (13) re-tested showed seasonal variations.

Main Contributions of the Project
The project contributed in the following ways:

- Finding the information about the quality of water in Peddie
- Making the information available to the authorities and communities
- By providing feedback to the communities, capacity was built and awareness raised for the communities to lobby the government in providing the infrastructure
- Valuable recommendations were submitted to the national and provincial water policy authorities to improve the current efforts by improving the quality of water in the Eastern Cape.

Methodology

Selection Criteria for the Study Area
Four major indicators guided the implementation of the project, namely:

Coverage:	the proportion of the population served and the proximity of the water to the place of use
Continuity:	the reliability of supply throughout the day and year
Quality:	bacterial and chemical quality of water and
Quantity:	the quantity of water available per use per day

Distribution of Questionnaires: Questionnaires were distributed in 25 villages in the Peddie district. Existing Water Committees were identified and enlisted for their co-operation in the distribution and completion of the questionnaires. Meetings were held with Water Committee members from the 25 different villages where questionnaires were distributed and administered.

Sample collection
Microbiological, major inorganic and trace metal samples were collected from all water sources according to procedures described in a sampling manual provided by the Institute for Water Quality Studies (IWQS)(DWAF, 1995). Sample bottles were supplied by IWQS and prepared for sampling according to the procedures prescribed by the IWQS laboratory.

At each sampling point, additional information such as precise geographical location as well as land-use activities that could affect the water quality of the source was recorded on data collection sheets (DWAF, 1995).

Microbiological Samples
All outlets at taps and hand pumps of boreholes were sterilized by means of a gas burner before collection. No sterilization was done on samples taken from rivers, pans, dams, wells and springs. All microbiological samples were collected in sterilized bottles and kept in cooler boxes with ice at 4ºC prior to analysis (DWAF, 1995).

Major Inorganic Constituent Samples
The samples that were sent to the IWQS for major inorganic chemical analyses were collected in clean bottles, preserved with mercury II chloride ($HgCl_2$) and stored at room temperature prior to analysis (DWAF, 1995).

Trace Metal Samples
Trace metal samples were collected in specially cleaned bottles. No preservatives were added to the samples which were stored at room temperature prior to analysis (DWAF, 1995).

Sample analysis

Microbiological samples
The samples were analyzed at the University of Fort Hare within 6-24 hours from the time of collection. The membrane filter method was used (DWAF, 1992).

Chemical Constituent Analysis
Sample analysis was done at the accredited laboratories of the IWQS (DWAF, 1992). All samples were analyzed according to standard analytical procedures for the constituents. This was done for all the villages in summer and, for a selected few, in winter to determine probable seasonal variation.

A report back to communities about the quality of their water was done and people had different responses **(SEE APPENDIX C)**. Together with the report, a questionnaire that was designed and translated into Xhosa was included to determine the patterns of water use. The Education Policy Unit at Fort Hare was consulted for statistical data analysis.

Correlation between Research Objectives and Remedial Action
The objectives of the study were achieved as follows:

- The determination of the quality of water at the point of provision was successfully addressed. Re-testing of water quality at selected sites showed little variation and indicated that seasonal climatic changes would not affect water quality significantly
- Determining the patterns of water use, including that used for farming, drinking, washing and other hygiene purposes, including the quantity of water used for and identification of the treatment of water by the end-user prior to use. The patterns of water use were identified, but the quantity of water used was not addressed
- Given the limited resources available to the project, developing, testing and evaluating water surveillance techniques incorporating sanitary inspection and water quality monitoring, were not undertaken.
- Provide a scientific basis for prioritizing remedial action strategies, which will protect the user from the risk of waterborne diseases. Social awareness was raised during the report back and people were asked to use industrial bleach, fire, sedimentation, and the sun as means of treatment.

Recommendations

- It is recommended that urgent attention be given to the provision of alternative water sources for domestic potable use.

- Water sources must be fenced in to protect water from being contaminated by domestic animals.

- The use of the sun and sedimentation as short-term water treatments is strongly recommended, as there are no financial costs involved. However, these methods can pose problems at certain times e.g. when it is cloudy or in winter and when, in the case of sedimentation, people cannot afford to wait for days before using the water.

- Industrial bleach and boiling are also recommended to disinfect water collected from faecally polluted water sources, irrespective of the season, because the results for seasonal variation sampling showed that seasonal change had little effect on the overall water quality. However, in terms of financial costs, communities reported that they cannot afford bleach, and women cannot afford to use firewood for boiling water because the firewood had to be used for cooking.

- Because the above recommendations are for short-term use and pose problems at times, appropriate water treatment plants should be considered as a long-term solution.

- To be cost-effective and sustainable, local communities themselves must be trained to operate simple treatment facilities.

- Communities must be informed about the quality of their water sources. The information will enable them to make informed decisions regarding the correct use of available water.

- Findings of this research should be used in workshops nationally to give an indication of how this research was done and to educate people on capacity building.

- It is essential for the planning of future water quality surveillance programmes to uniquely identify all water sources used for domestic water supplies in rural areas. A unique and permanent source identification number (source ID e.g. H No. or ZQC No.) for every sampling point (boreholes and springs only) is essential for future and data recording purposes. This number must be cemented in at the sampling point or posted to each source and placed in a prominent position. Reference to it should be compulsory each time a sampler or researcher visits the source for monitoring purposes.

Archiving of data

Raw data for both the Interim and the Final Reports will be available from the University of Fort Hare and from the Water Research Commission.

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LIST OF ACRONYMS

CSIR	-	Council for Scientific and Industrial Research
DWAF	-	Department of Water Affairs and Forestry
H No. or ZQC	-	Source for every Sampling Site
ID	-	Identification Number
IMF	-	International Monetary Fund
IWQS	-	Institute for Water Quality Studies
P/kl	-	per Kilolitre
RDP	-	Reconstruction and Development Programme
SABS	-	South African Bureau of Standards
SAP	-	Structural Adjustment Programme
WRC	-	Water Research Commission

As	-	Arsenic
B	-	Borehole
C	-	Calcium
Cd	-	Cadmium
Cl	-	Chloride
EC	-	Electrical Conductivity
F	-	Fluoride
F	-	Spring
FC	-	Faecal Coliforms
Fe	-	Iron
HgCl 2	-	Mercury 2 Chloride
K	-	Potassium
Mg	-	Magnesium
Mn	-	Manganese
Na	-	Sodium
NO_3+NO_2 as N	-	Nitrate plus nitrate as N
P	-	Dam
PH	-	Potential Hydrogen
R	-	River
Seq. No.	-	Sequence Number
SO_4	-	Sulphate
Zn	-	Zinc

CHAPTER 1

1. INTRODUCTION

1.1 Rationale

In the natural environment, there is no pure water available for general use. All water, including rainwater, has some impurities. The impurities are commonly in the form of dissolved solids or gases, suspended solids and microorganisms. The importance of water as a vehicle for the spread of disease is the main concern in terms of water quality control. However, certain other quality parameters may also be of concern, for example the aesthetics of the water (clarity and taste) and the corrosivity or scale-forming potential (Water Research Commission, 1996).

South Africa, like most developing countries, is experiencing rapid population growth, as well as rapid urbanization in and around the country. This accelerated population growth occurs in the impoverished socio-economic environment, with limited water resources and poor sanitation. An increase in diseases associated with poor living conditions often results. Among these, water-related and waterborne diseases play a major role.

As enunciated in the *Water Supply and Sanitation Policy*, (1994), the "lack of basic services such as water supply and sanitation is the key symptom of poverty and underdevelopment". The provision of such services must be part of a coherent development strategy if it is to be successful.

The White Paper has urged that the way in which South Africa's limited water resources are used must also be part of such a development strategy. The creative management and use of water will also be vital to assure the Reconstruction and Development Programme objectives, the eradication of poverty and promoting sustainable and social development.

The types of chemicals present in groundwater relate to the different types of host rock. The chemical composition of water changes as it flows through the ground, thus the sample from the same lithostratigraphic unit frequently has different absolute and relative chemical concentrations (Allen, 1965 cited by Le Roux and Le Roux, 1994).

The Eastern Cape Province, which is the second poorest Province in South Africa, is faced with poor living conditions, which result in an increase in diseases. Peddie district in the Eastern Cape is a rural area, which lacks basic needs such as water supply and sanitation services, which are the key symptoms of underdevelopment. Peddie was observed to have limited water sources, which are unprotected, and these same sources are used by livestock. These conditions are associated with an increase in water-related diseases because of the poor water quality.

1.2 Objectives

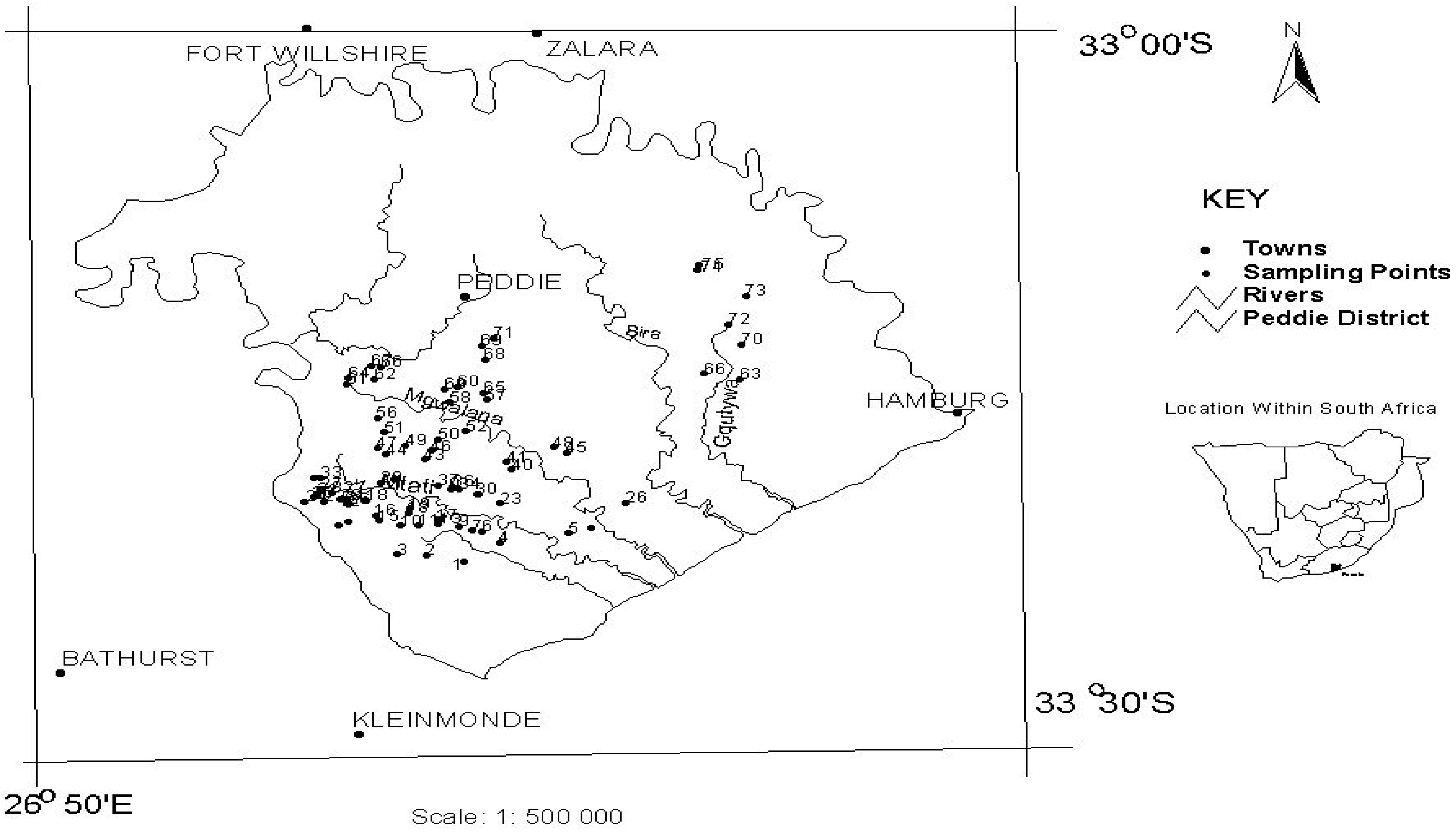
The objectives were as follows:

- The determination of the water at the point of provision;
- Examination of patterns of water usage, including water used for farming, drinking, washing and other hygiene purposes, including the quantity of water used, and identification of the treatment of water by the end-user prior to use;
- Develop, test and evaluate water surveillance techniques incorporating sanitary inspection and water quality monitoring;
- Provide a scientific basis for prioritizing remedial action strategies, which will protect the user from the risk of waterborne diseases.

1.3 Outline of the structure of the Report

Peddie district was selected as a study area because it has limited water sources of poor quality. Questionnaires were distributed in 25 villages of Peddie (see Map 1) to identify the types of water sources available. Water Committees were enlisted for the distribution and completion of questionnaires. Water samples were collected from each water source and analyzed. Microbiological quality of the water samples were assessed using faecal coliforms as the standard bacterial indicator organisms for the drinking water. Chemical quality of the water was assessed using major inorganic and trace metal samples. The Water Assessment Guide by the Water Research Commission was used for the classification of water quality. A report back to communities about the quality of water was done to raise awareness and to empower the communities to lobby the government in providing infrastructure.

Map 1: Geographic Location of the Peddie District



CHAPTER 2

2. LITERATURE SURVEY

2.1. Introduction

In the natural environment, there is no pure water available for general use. All water, including rainwater, has some impurities. The impurities are commonly in the form of dissolved solids or gases, suspended solids and microorganisms. The importance of water as a vehicle for the spread of disease is the main concern in terms of water quality control. However, certain other quality parameters may also be of concern, for example the aesthetics of the water (clarity and taste) and the corrosivity or scale-forming potential (Water Research Commission, 1996).

The types of chemicals present in groundwater are related to the different types of host rock. The chemical composition of water changes as it flows through the ground, thus the sample from the same lithostratigraphic unit frequently have different absolute and relative chemical concentrations [Allen, 1965 cited by Le Roux and Le Roux, (1994)].

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The Water Supply and Sanitation Policy (1994), indicates that the "lack of basic services such as water supply and sanitation is the key symptom of poverty and underdevelopment". The provision of such services must be part of a coherent development strategy if it is to be successful.

The White Paper has urged that the way in which South Africa's limited water resources are used must also be part of such a development strategy. The creative management and use of water will also be vital to assure the Reconstruction and Development Programme objectives, the eradication of poverty and promoting sustainable and social development.

The Eastern Cape Province, which is the second poorest Province in South Africa, is faced with poor living conditions, which result in an increase in diseases. Peddie district in the Eastern Cape is a rural area, which lacks basic needs such as water supply and sanitation services, which are the key symptoms of underdevelopment. Peddie was observed to have limited water sources, which are unprotected, and these same sources were used by livestock. These conditions are associated with an increase in water-related diseases because of the poor water quality.

2.2. The *Status Quo* in Rural Water Supply in South Africa

According to the Reconstruction and Development Programme (RDP), (1994), water is a natural source, and should be made available in a "sustainable manner" to all South Africans. In this country, access to water is thus considered a basic human right. In 1994, it was estimated that out of a population of 43 million, an estimated 12 million South Africans do not have sufficient access to clean potable water and 21 million people do not have adequate sanitation (Miller, 1994).

Some of these 12 million make do with polluted surface water, some queue day and night at hand pumps, others walk for kilometers to wells, dams, springs and rivers, and some purchase water from vendors at a cost they can barely afford (R10- R50 p/kl). Most of these people are using water on a daily basis that is hazardous to their health (RDP, 1994; Mogane, 1989).

According to available data, there is a combination of factors that relate to the issues of water supply, namely, the problem of provision, which is first and foremost related to the absence of infrastructure; the inadequacy of the infrastructure in relation to the population served, and ineffective management of adequate infrastructure. Notably, no account has been taken of the quality of water from piped, borehole or protected spring sources, which are usually considered to be adequate (RDP, 1994).

2.3. Water-Related Diseases

A water-related disease is one which is related to water in the environment or to impurities within the water. Water-related diseases may be divided into those which are caused by a biological agent of disease (a pathogen), or those that are caused by certain chemical substances in water. The water-related infections are so described because their transmission depends in part upon water. There are four categories of water-related diseases, and these include waterborne, water-washed and water-vectored diseases (Genthe and Seager, 1996).

2.4. Geological Influences on Chemical Water Composition

The types of chemicals present in groundwater are related to the different types of host rock. The chemical composition of water changes as it flows through the ground, thus samples from the same lithostratigraphic unit frequently have absolute and relative chemical concentrations.

Boreholes and springs often provide better water quality than surface sources because they tend to have less biological and turbidity pollution. However, groundwater sources may cause health and aesthetic problems due to constituents dissolved out of the host rock.

The Peddie district is made up of five major rock types viz: Adelaide Subgroup, the Ecca Group, the Dwyka Group, and the Traka Group (Johnson, 1976 cited by Johnson and Le Roux, 1994) (see Map 2).

2.5. Basic Needs for Water and Health

The transmission of diseases by polluted water has a long history and remains a problem to this day. It has been estimated that 50,000 people die daily worldwide as a result of water-related diseases. Pathogenic microorganisms responsible for causing diseases in humans include bacteria, viruses, and parasites. Contaminated water not only holds the potential to cause human suffering, but also results in economic loss (Venter, 1996).

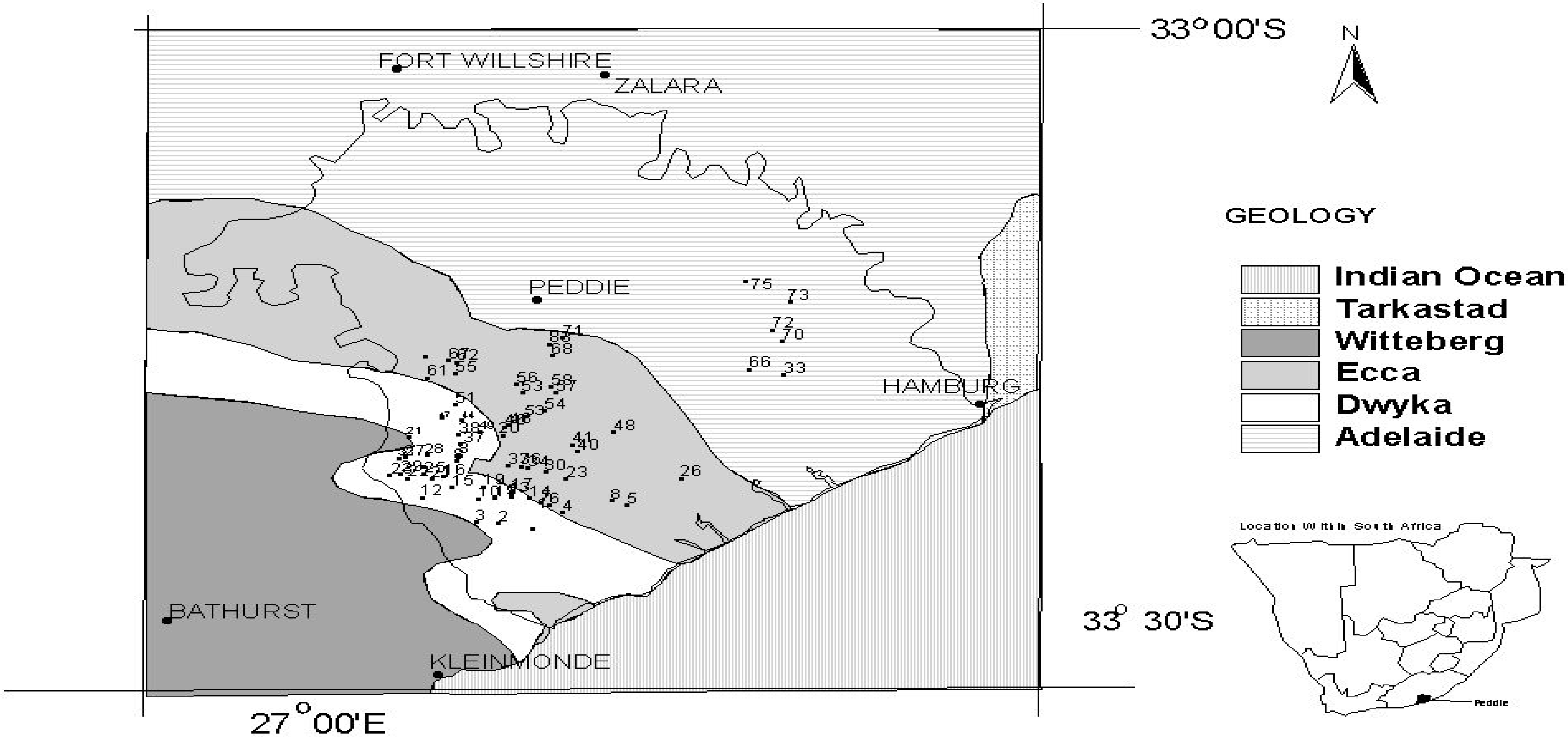
In 1997, the World Health Organization, in its call for "Health for All by the Year 2000", endorsed its belief that health is a fundamental human right and a world-scale social goal. Its 1997 report emphasized that health development is essential for social and economic growth and sustainable development: that the means of attaining all three are intimately linked, and that any actions taken to improve health or socio-economic situations should be treated as mutually supportive, not competitive (MacGregor, 1991).

In South Africa, there is a wide-spread scarcity, gradual destruction and increased pollution of freshwater sources. All these situations are applicable to the situation in Alice and all formerly black townships in the Eastern Cape Province. The growing population and their economic needs, as well as the poor progress in sanitation facilities in this area constitute a threat to the water resources, and drinking water in particular. Faecal coliforms in drinking water constitute a threat to the safety of the water because this indicates the potential of the water to cause an outbreak of waterborne diseases (Muyima and Ngcakani, 1998). This, therefore, makes the quality of drinking water the central focus of this research project.

The need to provide suitable and adequate water and sanitation to the communities is a well-recognised central component of the South African Government's Reconstruction and Development Programme. In particular, water supply to the disadvantaged communities is being addressed by a number of schemes and programmes. However, a vital component, which has not been afforded sufficient attention, is the drinking-water quality aspects of both existing and new rural water supply schemes. The microbiological quality of drinking water is of the greatest importance and must never be compromised in order to provide aesthetically pleasing water. The chemical risks associated with drinking water can be regarded as being of a secondary nature in comparison to microbiological risks (Water Research Commission, 1996).

In the Drinking Water Quality Management research by the Council for Scientific and Industrial Research (CSIR) for rural community water quality and management practices, microbiological sampling was limited to the South African Bureau of Standards (SABS) 24 indicator organisms, namely heterotrophic plate count total coliform and faecal coliform. The results showed that in the 83 percent of the communities more than 65 percent of the samples collected failed 241 maximum allowable limits. Of the 12 communities sampled, in only one community did all samples collected satisfy (SABS) recommended and maximum limits (CSIR, 1991).

Map 2:Geological units in the Peddie District



Scale: 1: 500 000

The findings demonstrated that, in the Western Cape, poor drinking water quality exists in many small communities/towns, and that water sampling and water quality management are inadequate.

Significantly, it is the rural populations, which are suffering from microbial or chemical contamination of drinking water. Their numbers are overwhelmingly high and increasing at a rate, which makes it extremely difficult for water supply and sanitation programmes to achieve significant improvements over and above demographic improvements. One study has indicated that the needs of rural areas in the developing countries are shown by the fact that in 1980, less than one third of the rural population was provided with satisfactory drinking water supply schemes as compared to about three quarters of the people living in the towns (Lloyd and Helmer, 1991). Undoubtedly, the situation is likely to have deteriorated alarmingly in African countries which are entrapped in IMF (International Monetary Fund) sponsored Structural Adjustment Programmes (SAP's), which target, *inter alia*, budget cuts in social services such as water supply and sanitation programmes.

Lloyd and Helmer have argued, however, that much could be done to improve health and reduce infant mortality if water supply services were up to standard. According to Lloyd and Helmer that although it is quite obvious that the pathogen-contaminated drinking water is a prime source of infection, it is equally true that the insufficient availability of water restricts people's efforts to practise good personal and domestic hygiene. The inevitable consequences are high diarrhoeal and skin disease incidences (Lloyd and Helmer, 1991).

The correlation between improved drinking water and improved personal hygiene as contributory factors in an improved health pattern in the population is also emphasized in another study on the subject of drinking water quality in the rural areas. Morgan (Morgan, P (1990)) argues that there is very little scientific evidence that shows conclusively that the provision of improved quality of drinking water alone will result in an improved health status of the rural inhabitants. In this context, improved drinking water can only be gained when individuals practise improved personal hygiene. According to Morgan, some studies show clearly that the provision of soap together with the campaign to improve hand-washing practice had a far greater impact on diarrhoeal diseases than the simple provision of improved water supplies alone. The importance of good hygiene practice as an effective method of reducing morbidity due to enteric diseases is becoming more widely acknowledged.

Alongside improved water quality and quantity, as well as personal hygiene, habits concerning water use (for example, the mode of transportation and the vessel in which the water is immediately stored) and excreta disposal should change, if there is to be a reduction in the incidence of waterborne and sanitation diseases. The basis of this observation system form the notion that few medical conditions caused by biological and chemical impurities in the drinking water supply can be remedied without the community's participation and cooperation. Installation of such water and sanitation services is, obviously, a prerequisite if the community health of rural people is to benefit, but it is far from being the sole determining factor (Black, 1990).

Finally, the demand for improved and safe water supplies among rural populations in the developing countries and, therefore, its popularity, is driven not only by the expectation of improved health conditions, but also by the enormous gain in accessibility to something fundamental to human existence.

2.6 Methodology

2.6.1. Selection Criteria for the Study Area

Four major indicators guided the implementation of the project, namely:

Coverage: the proportion of the population served and the proximity of the water to the place of use;

Continuity: the reliability of the water supply throughout the day and year;

Quality: bacterial and chemical quality of water; and

Quantity: the quantity of water available for use per day.

2.6.2 Distribution of Questionnaires

Questionnaires were distributed in 25 villages in the Peddie district to identify management facilities, types of water supply systems, existing water sources, existing water supply infrastructure, and patterns of water use. Existing water committees were identified and were enlisted for their cooperation in the distribution and completion of the questionnaires. Meetings were arranged and held with the water committee members from the 25 different villages, where questionnaires were distributed and administered.

2.6.3. Sample Collection

Microbiological, major inorganic and trace metal samples were collected from all water sources according to the procedure in a sampling manual provided by the Institute for Water Quality Studies (IWQS)(DWAF, 1995). Sample bottles were supplied by IWQS. The bottles were cleaned and prepared for sample collection according to the procedures used in the IWQS laboratory (DWAF, 1995).

At each sampling point, additional information such as precise geographical locations as well as land use activities that could affect the water quality of the source, were recorded on data collection sheets (DWAF, 1995).

2.6.3.1. Microbiological Samples

All outlets at taps and hand pumps of boreholes were sterilized by means of a gas burner before sample collection. No sterilization was done on samples taken from rivers, dams, pans, wells and springs. All the microbiological samples were collected in sterilized bottles and were kept in cooler bottles with ice at 4ºC prior to analysis (DWAF, 1995).

2.6.3.2. Major Inorganic Constituent Samples

The samples that were sent to IWQS for major inorganic chemical analyses were collected in clean bottles, preserved with mercury II chloride ($HgCl_2$) and stored at room temperature prior to analysis (DWAF, 1995).

2.6.3.3. Trace Metal Samples

Trace metal samples were collected in specially cleaned bottles. No preservatives were added to the samples and were stored at room temperature prior to analysis (DWAF, 1995).

2.6.4 Sample Analyses

2.6.4.1. Microbiological Samples

The samples were analyzed at the University of Fort Hare within 6-24 hours from the time of sample collection. The membrane filter method was used (DWAF, 1992).

2.6.4.2. Chemical Constituent Analyses

Sample analysis was done at the accredited laboratories of the IWQS (DWAF, 1992). All samples were analyzed according to standard analytical procedures for the constituents. This was done for all the villages in summer and for a selected few in winter to determine probable seasonal variations.

2.6.5. Assessment Criteria

Water quality is defined in terms of its microbiological, physical and chemical characteristics. In this report the classification system used to evaluate the safety of domestic water supplies was developed jointly by the Department of Health, Department of Water Affairs and Forestry, and the Water Research Commission. Only constituents that cause health problems or affect aesthetic acceptability at elevated concentrations have been included in the classification system (see Appendix A). The system classifies drinking water into five classes ranging from class 0 to class IV. The worst class of any of the constituents is taken as the overall class of that particular water source. For example, if any of the constituents fall in class IV then the water is classified as class IV. In order to simplify the interpretation of the water quality results, the classification system was coupled to colour codes (WRC, 1998).

CHAPTER 3

3. RESULTS

3.1. Existing Water Sources

Water sources in the Peddie district comprise of:

- Boreholes fitted with hand pumps
- Boreholes fitted with windmills and connected reservoirs
- Springs and wells
- Dams mainly derived from water collecting in holes created during road construction works

Map 3 is a graphical representation of water sources in the Peddie district of the Eastern Cape Province.
The symbols represent water sources in respective villages. The meaning of the different symbols is depicted in the key associated with the map.

3.2. Management Facilities

The information which was received from the respondents showed that only 6 percent indicated that no local management facilities exist, while 94 percent indicated that water committees or other local, district and regional bodies exist, but in some of these cases, they show no interest in management of the facilities. In the majority of cases, these bodies are also lacking managerial capabilities, technical skills and funds in order to function effectively. Only a few were reported to be functional.

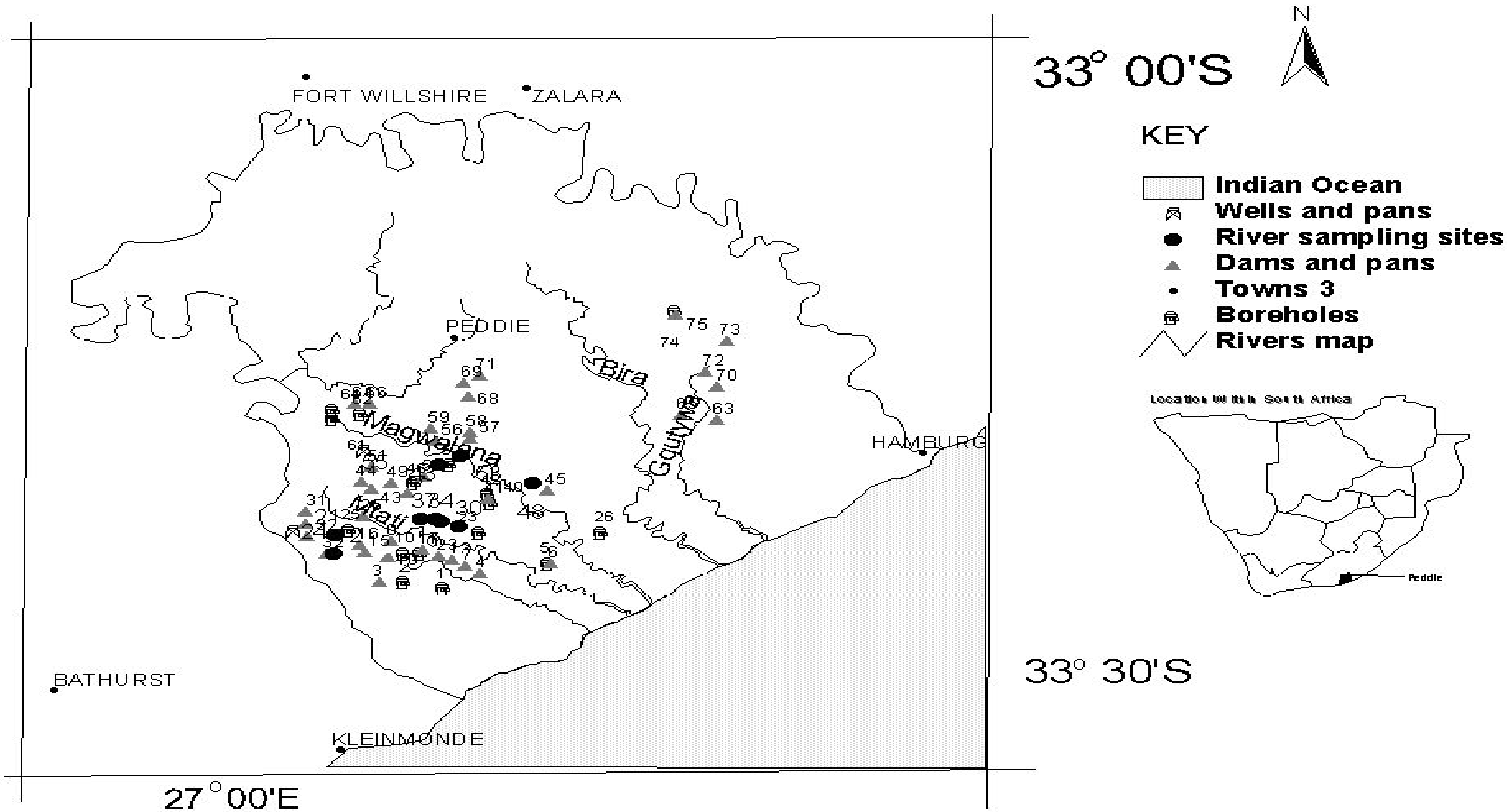
3.3. Existing Water Supply Infrastructure

In 27 percent of the communities using either rivers, dams or springs, there is no infrastructure. In the 73 percent who reported some infrastructure, mostly pumps, windmills and reservoirs, 57 percent reported that some of these facilities are either damaged, destroyed or in need of repair. There seems to be some confusion, or lack of knowledge about the capacity of the infrastructure to serve the various communities. In the cases where infrastructure exists, it was reported that the original capacity was sufficient for only 61 percent of the population, and can now only serve 40 percent at the minimum RDP level.

3.4. Patterns for Water Use

In the Peddie district, everybody uses water from the above sources for cooking, yet a huge percentage of 83.3 percent say this water is not fit for human consumption. 72.2 percent of the population use the same water for irrigation. 92.3 percent use the same water for washing. All villages share their surface water with their livestock. Not even a single village indicated water treatment before use. After using the water, 14.3 percent of the community reported that they had closed separate drains for dumping sullage. Another 14.3 percent have open separate drains, 33.3 percent dump their sullage into the streets and 38.1 percent dump their sullage in the household yard.

Map 3: Water Sources in the Peddie District of the Eastern Cape Province



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3.5 Seasonal Variation Sampling

Re-sampling was done in the few selected villages, which had serious problems, to check for seasonal variation, if any, and as a re-check for sources that showed high nitrates and fluorides in 1997. The total number of samples taken for the initial survey (February and August 1997) was 75 and the total number to be re-sampled was 16. Re-sampling was done in 13 villages because in two villages, viz. Mthathi-KoMkhulu and Newtondale sources were dry, and at Ngqowa-Esigingqini the borehole was broken (see Appendix B).

From the results obtained, it was gleaned that the quality of water in the sources at Mthathi-Masango, Ngqowa-Mkhanyeni, and Upper-Gwalana was unaffected by the seasonal change, the overall class remaining the same.

The overall class changed from 4 in summer to 3 in winter at Ntshamanzi, Mthathi-Masango and Ntshamanzi-Mabaleni. This means that the quality of water in these sources is better in winter than in summer. At Mphekweni, Mthathi-Mbokothwana, and Ngqowa-Mkhanyeni the overall class changed for the better, i.e. from class 4 in summer to class 2 in winter.

At Nobumba the change in season did not affect the overall class of water quality because it remained in the same class, viz. class 4. There was a negligible difference on the fluoride concentrations for both seasons as both concentrations fell in the same class 4 as in summer.

At Ntloko the number of feacal coliforms was very high in winter compared to that in summer and was classified as class 4, which means that the change in season does not affect the number of feacal coliforms in this source. There was an increase in Nitrate concentrations in winter when compared to that in summer, but for both seasons the Nitrate concentrations fell in class 3.

At Tuba, for both seasons the Nitrate concentrations fell in class 3, even though there was a slight decrease of the concentrations in winter.

The change in season has little effect on the overall class of water quality. This is proved by the fact that out of the 13 villages re-sampled, only 6 villages showed a change in the overall class; in the other villages there was no change.

3.6 Intersectoral Cooperation

The pilot study confirmed that intersectoral cooperation played a key role in the planning and operation of water quality surveillance programmes. The interest and support by all the role players that participated in the study indicated that it would be possible to create the necessary intersectoral structures to operate surveillance programmes in a coordinated and integrated way. Advantages of intersectoral cooperation are the creation of a common understanding by the role-players of the water quality problems experienced by communities, thereby providing opportunities to solve water quality problems in a much more holistic way.

Duplication of programmes is thus avoided and scarce funds and other resources are utilized much more efficiently. However, programmes will have to be carefully designed and the objectives of each of the role players will have to be stated clearly in order to avoid a “game keeper” and “poacher” situation. This success story can be expanded to include other institutions of higher learning nationally who are involved in water-related research.

TABLE 1: Sources used by villages and their condition

Name of village	Population	Percentages of rainwater Storage Tanks per household	Amount of Borehole	Borehole Condition		Spring/Well	Dams	River
				Functional	Non - Functional			
Mahlubini	865	78	2	1	1	0	1	0
KwaTuba	325	22	2	2	0	0	0	0
Nobumba	1588	69	3	3	0	0	0	0
Woodlands	557	70	2	0	2	0	1	0
Qeto	1493	15	3	1	2	0	1	0
Nyeleni	749	59	2	1	1	0	1	2
Ngqowa-Esiginqini	991	73	2	2	0	0	0	4
Mthathi-komkhulu	500	15	1	0	1	0	30	0
Ngqowa-mkhayeni	853	81	2	0	2	0	5	0
Mphekweni	54	76	4	0	4	0	2+t	0
Prudhoe	658	44	1	1	0	0	0	0
Zweledinga	1712	71	3	0	3	0	1	0
Mthathi-mbokotwana	750	37	0	0	0	0	1	1
Mthathi-masango	844	68	0	0	0	0	1	0
Ntshamanzi	1002	70	3	1	2	0	3	1
Upper-gwalana	804	53	2	0	2	0	3	0
Newtondale	222	33	1	0	1	2	1	0
Ntshamanzi-mabaleni	456	60	1	0	1	0	1	1
Mgwalana	869	57	3	3	0	2	1	0

Out of the 77 sources visited, 59 percent of the boreholes were non-functional because of broken or damaged infrastructure. There was also a high level of use of untreated surface water from rivers, dams and wells, with 51.9 percent of the total number of sources being surface water sources being used without any form of treatment. This percentage increases to 80 when these sources are calculated as a percentage of functional sources. Surface water sources include rivers, dams and wells. Information about the population of each village was received from the Department of Water Affairs in King Williams Town.

CHAPTER 4

4. DISCUSSION OF RESULTS

4.1. Assessment of Health-Related Water Quality in the Study Area

A total of 75 samples were analyzed for faecal coliform bacteria as well as the major inorganic constituents and trace metals of concern. The constituents were individually classified in terms of suitability for drinking water according to the classification system. The last column in the table indicates the overall classification of a particular source. The exact geographic position of each water source is indicated by dots (see Map 4). The colour of the dot corresponds to the colour code of the classification of each water source.

4.2. Water Quality in Different Water Sources

Ground- and surface water sources in the Peddie district are discussed separately below in order to highlight the different patterns revealed by each in terms of their chemical as well as bacteriological features. The impact that geology as well as the land use activities might probably have contributed to the water sources, are also briefly described.

The chemical composition of water changes as it flows through the ground, thus samples from the same lithostratigraphic unit frequently have different absolute and relative chemical concentrations. Groundwater sources often provide better quality water compared to that of surface water due to the former being less likely to be microbiologically polluted. Visual observation was that borehole samples were generally clear compared to that of turbid surface water.

Map 4 : Classification of Sampling Sites

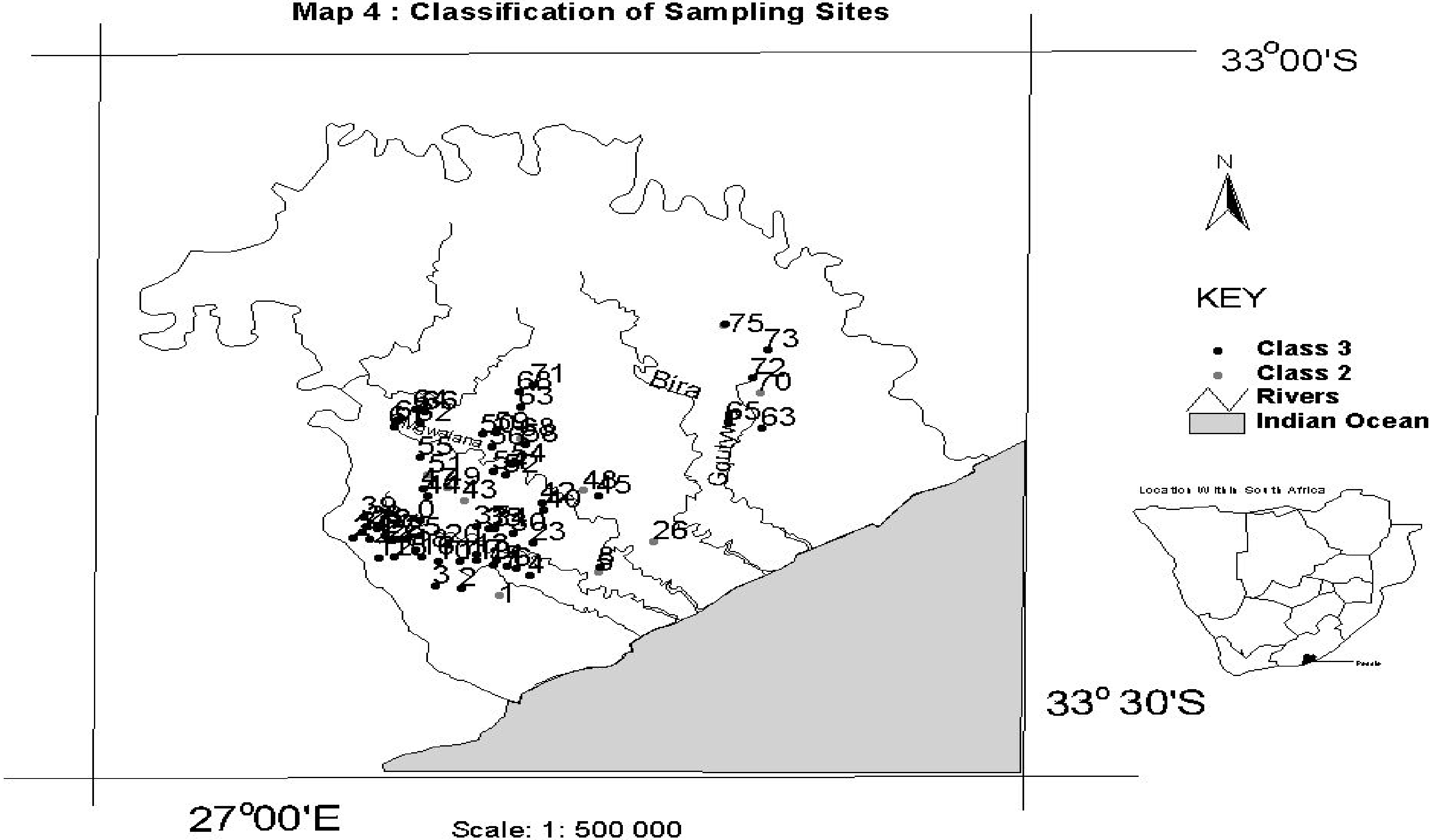

Table 2: A Summary of the Water Sources Requiring Attention in the Peddie District

Village	Seq. No	Source	Latitude	Longitude	Overall class	Problem Constituent		Probable Causes
						Health-effects	Aesthetic	
Ngqowa-Mkhanyeni	4	Dam	33 23 20	27 08 54	4	FC****	Fe**Mn*	FC = Source unprotected; Laundry; (Fe, Mn) = Geology
Ngqowa-Mkhanyeni	6	Dam	33 22 55	27 08 11	4	FC****	Mn*Cl**Fe*	FC = Source unprotected ; Laundry; Pit latrine; (Mn, Cl, Fe) = Geology
Ngqowa-Mkhanyeni	7	Dam	33 22 50	27 07 43	4	FC****	Fe*	FC = Source unprotected; Laundry swimming; (Mn, Cl, Fe) = Geology
Benton	8	Dam	33 22 48	27 12 14	4	FC****	Fe****	FC = Source unprotected; (Mn, Fe) = Geology
Ngqowa-Mkhanyeni	9	Dam	33 22 44	27 07 09	4	FC****	Fe*	FC = Source unprotected; Fe =Geology
Mphekweni	10	Dam	33 22 42	27 04 46	4	FC****	Fe** Mn*	FC = Source unprotected; Laundry; Mn = Geology
Mphekweni	11	Borehole	33 22 37	27 06 36	4	FC****		FC = Source unprotected; Fe = Geology
Mphekweni	13	Borehole	33 22 34	27 06 18	4	FC*** [EC]	EC***	FC = Source unprotected; (pH, EC, K, Fe) = Geology
Ngqowa-Mkhanyeni	14	Dam	33 22 33	27 07 12	4		Fe** Mn*	FC = Source unprotected; (Mn, Fe) = Geology
Mphekweni	17	Dam	33 22 19	27 06 19	4	FC****	Fe**** Mn**	FC = Source unprotected; (Mn, Fe) = Geology
Mthathi-komkhulu	19	Dam	33 22 03	27 05 00	3	FC***		FC = Source unprotected
Mthathi-komkhulu	20	Dam	33 21 54	27 05 03	3	FC***	Fe*	FC = Source unprotected; Fe = Geology
Bingqala	45	Dam	33 19 14	27 11 48	3	FC***	Fe**	FC = Source unprotected (Mn, Fe) = Geology
Mgwalana upper	56	Dam	33 16 54	27 06 44	3	FC***	Fe***	FC = Source unprotected Fe = Geology
Celetyuma	57	Dam	33 16 49	27 08 21	4	FC****	Fe*	FC = Source unprotected laundry Fe = Geology
Mgwalana	59	Dam	33 16 21	27 06 28	3	FC***	Cl**	FC = Source unprotected; Cl = Geology
Leqeni	73	Dam	33 11 49	27 19 21	3	FC***	Fe**	FC = Source unprotected; Fe, = Geology
Mgwalana	60	Borehole	33 16 16	27 07 02	3	[Na, EC Cl]	Na***Mg**EC***Cl***Mn*	(Na, Mg, EC, Cl, Mn) = Geology
Crossroads	75	Borehole	33 10 37	27 17 18	3		Cl*** Na**Mg*EC**	(Na, Mg, EC, Cl) = Geology
Benton	5	Borehole	33 22 58	27 11 59	2		Na**Cl**	(Na, Cl) = Geology
Bingqala	48	River	33 18 59	27 11 10	2		EC*Cl**	(EC, Cl,) = Geology
Crossroads	74	Dam	33 10 40	27 17 18	2		Fe**	Fe = Geology
Celetyuma	58	Dam	33 16 31	27 08 10	2		Fe**	Fe = Geology

NB [Na, EC & Cl] OCCUR IN CONCENTRATIONS THAT WOULD CAUSE HEALTH PROBLEMS IN THE SOURCE/S TO SENSITIVE USERS AS WELL AS AESTHETIC EFFECTS TO NON-SENSITIVE USERS

Table 3 : A Summary of the Water Sources Requiring Attention in the Peddie District

Village	Seq. No	Source	Latitude	Longitude	Overall class	Problem	Constituent	Probable Causes
						Health-effects	Aesthetic	
Nyaniso	68	Dam	331453	270807	4	FC****		FC = Source unprotected Faecal matter nearby
Nyaniso	69	Dam	331413	270801	3	FC***	Fe**Cl**	FC = Source unprotected Faecal matter nearby (Fe, Cl) = Geology
Mthathi- Mbokotwana	12	Dam	332236	270200	4	FC****	Cl**	FC = Source unprotected Cl = Geology
Mthathi- Mbokotwana	15	River	332231	270226	4	FC****[Na, Cl]	Na*** Cl***EC**	(Na, Cl, EC) = Geology
Mthathi-	16	Dam	332225	270345	4	FC****		FC = Source unprotected,
Mthathi- masango	18	Dam	332005	270337	4	FC**** [Na, EC,Cl]	Na***EC***Cl***Mg*	FC = Source unprotected, (Na, Cl, EC, Mg) = Geology
Ntshamanzi -mabaleni	21	River	332139	270226	4	FC****	Na***EC**Cl***	FC = Source unprotected, (Na, EC Cl) = Geology
Ntshamanzi -mabaleni	22	Dam	332136	270126	4	FC****		FC = Source unprotected,
Ntshamanzi -mabaleni	27	Well	332127	270216	4	FC****	Na**EC**Cl**	FC = Source unprotected, (Na, Cl, EC) = Geology
Ntshamanzi- Mabaleni	28	Well	332127	270207	4	FC****		FC = Source unprotected,
Ntshamanzi	29	Dam	332121	270058	4	FC****	Fe***Mn*	FC = Source unprotected, (Mn, Fe,) = Geology
Ntshamanzi	24	Well	332132	270034	4	FC****	Na**EC*Cl**	FC = Source unprotected (Na, EC, Cl) = Geology
Ntshamanzi	31	Well	332110	270109	4	FC****	Na**EC**Cl**	FC = Source unprotected (Na, EC, Cl) = Geology
Ntshamanzi	32	Well	332107	270145	4	FC****	Na**EC**Cl***	FC = Source unprotected (Na, EC, Mn, Cl,) = Geology
Ntshamanzi	33	Dam	332102	270117	4	FC****	Mn*Fe*	FC = Source unprotected laundry (Mn, Fe) = Geology
Newtondale	38	Dam	332041	270346	4	FC****		FC = Source unprotected
Ntshamanzi	39	Dam	332027	270113	4	FC****	Fe****Mn*	FC = Source unprotected (Fe, Mn) = Geology
Nyaniso	71	Dam	331349	270835	3	FC***	Fe***Mn*	FC = Source unprotected Faecal matter nearby (Fe, Mn) = Geology
Nobumba	64	Borehole	331545	270223	4	NO_3 ****[Na, & Cl]	Na***EC****Cl****	NO_3 = Source unprotected, Na, EC, Cl = Geology
Ntloko	55	Well	332735	270335	3	NO_3 ***FC**	Na**EC**Cl**	(FC, NO_3) = Source unprotected (Na, EC, Cl) = Geology
Nobumba	61	Borehole	331603	270216	3	[Na, Cl]	EC**Na***Mg**Cl***	Geology
Ntshamanzi	25	Borehole	332129	270309	3	[Cl]	Cl***EC**Fe*Na**Mg*	Geology
Ntloko	51	Dam	331820	270306	2		Fe**	Goelogy

Keys: **** = Class 4, *** = Class 3, ** = class 2, FC = Faecal coliforms; F = Fluoride

NB [Na, EC & Cl] OCCUR IN CONCENTRATIONS THAT WOULD CAUSE HEALTH PROBLEMS IN THE SOURCE/S TO SENSITIVE USERS AS WELL AS AESTHETIC EFFECTS TO NON-SENSITIVE USERS

Table 4 : A Summary of the Water Sources Requiring Attention in the Peddie District

Village	Seq. No	Source	Latitude	Longitude	Overall class	Problem Health effects	Constituent Aesthetic	Probable Causes
Ngqowa-esigingcini	35	Borehole	332056	270649	3	FC***	Na**EC**	FC = Source unprotected laundry, (Na, EC, Cl) = Geology
Ngqowa-esigingcini	36	River	332049	270652	4	FC****	Na***Cl***EC**	FC = Source unprotected laundry.(Na, EC, Cl) = Geology
Ngqowa-esigingcini	37	River	332048	270617	4	FC****[Na & Cl]	Na***Mg**EC***Cl***	FC = Source unprotected laundry.(Na, Mg, EC, Cl) = Geology
Ngqowa-esigingcini	23	Borehole	332133	270856	3	FC***NO_3**[Na, EC, Cl]	F***Na***EC***Cl***Mg*	(FC, NO_3) = Source unprotected, (Na, Mg, F, EC, Cl) = Geology
Ngqowa-esigingcini	34	Dam	332056	270710	4	FC****[Na & Cl]	Na***Cl***EC**	FC = Source unprotected, (Na, EC, Cl,) = Geology
Tuba	42	Dam	331939	270913	3	FC***	Fe**	FC = Source unprotected, Fe = Geology
Upper-Gwalana	44	Dam	331917	270400	3	FC***	Cl**Fe*	FC = Source unprotected, (Fe, Cl,) = Geology
Tuku C	63	Dam	331545	271906	3	FC***	Fe**Cl**Mn*	FC = Source unprotected, (Fe, Mn, Cl,) = Geology
Tuku B	65	Dam	331530	271736	3	FC***	Fe**	FC = Source unprotected, Fe = Geology
Nyeleni	53	River	331809	270658	4	FC****	Na**EC**Cl**	FC = Source unprotected, (Na, EC, Cl,) = Geology
Nyeleni	54	River	331745	270751	3	FC***	Na*EC**Cl**	FC = Source unprotected laundry.(Na, EC, Cl) = Geology
Upper-Gwalana	47	Dam	331905	270343	4	FC****		FC = Source unprotected laundry
Nyeleni	52	Borehole	3318216	270729	4	NO_3****[Na, EC, Cl]	Cl***Na**EC***MG*	NO_3 = Source unprotected, (Na, EC, Cl,) = Geology
Tuba	40	Borehole	332002	270924	3	NO_3***[Na, EC, Cl]	Cl***Na**EC***MG*	NO_3 = Source inadequately protected, (Na, Mg, EC, Cl,) = Geology
Prudhoe	1	Borehole	332416	270725	2		Na**EC**Cl**Mn*	(Na, EC, Cl,) = Geology
Thardfieid	26	Borehole	332127	271422	2		Na***EC***Cl**	(Na, EC, Cl,) = Geology
Ngqowa	30	River	332010	270757	3	[Na, Cl]	Na***Cl***EC**	(Na, EC, Cl,) = Geology
Tuba	41	Borehole	331941	270914	3	[Na, EC, Cl]	Na***EC***Cl***Mg*	(Na, EC, Mg, Cl,) = Geology
Qeto	43	Dam	331937	270540	2	FC**	Fe*	FC = Source unprotected, laundry, Fe = Geology
Qeto	46	Borehole	331912	270559	3	[Na, CL]	Na***Cl***EC**	(Na, EC, Cl,) = Geology
Tuku A	72	Dam	331317	271838	3	FC***	Fe**	FC = Source unprotected, laundry, Fe = Geology
Tuku A	70	Dam	331402	271907	2		Fe**	Fe = Geology

Keys: **** = Class 4, *** = Class 3, ** = Class 2, FC = Faecal coliforms; F = Fluoride

NB [Na, EC & Cl] OCCUR IN CONCENTRATIONS THAT WOULD CAUSE HEALTH EFFECTS IN THE SOURCE/S TO SENSITIVE USERS AS WELL AS AESTHETIC EFFECTS TO NON-SENSITIVE USERS

Table 5 : A Summary of the Water Sources Requiring Attention in the Peddie District

Village	Seq. No	Source	Latitude	Longitude	Overall class	Problem Constituent		Probable Causes
						Health-effects	Aesthetic	
Woodlands	66	Dam	331513	270342	4	FC****[Na, EC, Cl]	PH*Na***Mg**EC****Cl****	FC = Source unprotected (pH, Na, Mg, EC, Cl) = Geology
Zweledinga	3	Dam	332353	270434	3	FC***		FC = Source unprotected
Upper Gwalana	49	Dam	331856	270449	2		Cl**Fe**	(Cl, Mn, Fe) = Geology
Woodlands	62	Borehole	331550	270330	4	[Na, EC, Cl]	Na**** Mg**EC****Cl****	(Na, Mg, EC, Cl) = Geology
Woodlands	67	Dam	331510	270317	3	[Cl]	Cl***Na**Mg*EC**	(Na, Mg, EC, Cl) = Geology
Zweledinga	2	Borehole	332359	270547	4		Na***Fe****Cl***EC**	(Na, Fe, EC, Cl) = Geology

Keys: **** = Class 4, *** = Class 3, ** = Class 2, FC = Faecal coliforms; F = Fluoride

NB [Na, EC & Cl] OCCUR IN CONCENTRATIONS THAT WOULD CAUSE HEALTH PROBLEMS IN THE SOURCE/S TO SENSITIVE USERS AS WELL AS AESTHETIC EFFECTS TO NON-SENSITIVE USERS

4.2.1. Groundwater (boreholes)

A total of 18 borehole samples were collected in the Peddie district. Figure 1 depicts the overall water quality of borehole samples. 33 percent of the water sources were in class 4; 50 percent in class 3, and 17 percent in class 2. None of the water sources was in class 10, or in class1.

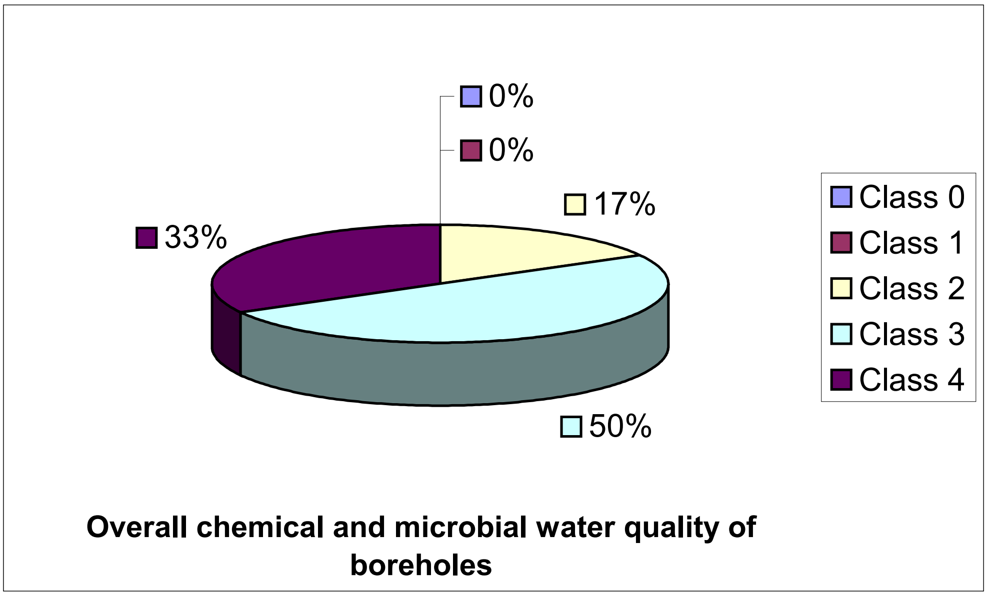

Figure 1: Overall Chemical and Microbial Water Quality of Boreholes

Slight taste problems may be caused by iron levels. The contribution of this metal in boreholes was found to be as follows:

- Iron accounted for 6 percent of the source in class 3.

The distribution of sodium (Na) and chloride (Cl) in classes 3 and 4 was 61 percent and 17 percent, respectively which is consistent with the 44 percent Electrical Conductivity values of classes 3 and 4.

Nitrates in boreholes were found to be as follows:

- 11 percent of sources were in class 4 at Nobumba and Nyeleni,
- 6 percent of sources were in class 3, one source at Tuba.
- The presence of Nitrates in groundwater could be originating from land-use activities, especially animal activities, on the surface.

Faecal coliforms (FC) accounted for 6 percent, and 6 percent of classes 2, 3 and 4, respectively. Pit latrines in the neighbourhood of sources could have had a bearing on the high counts obtained.

4.2.2. Surface Water: (Dams, Rivers, Springs and Wells)

Figures 2 and 4 represent overall surface water quality results of dams, springs and wells, respectively, in the Peddie district. Faecal pollution of rivers (70 percent); dams and pans (48 percent); springs and wells (80 percent).

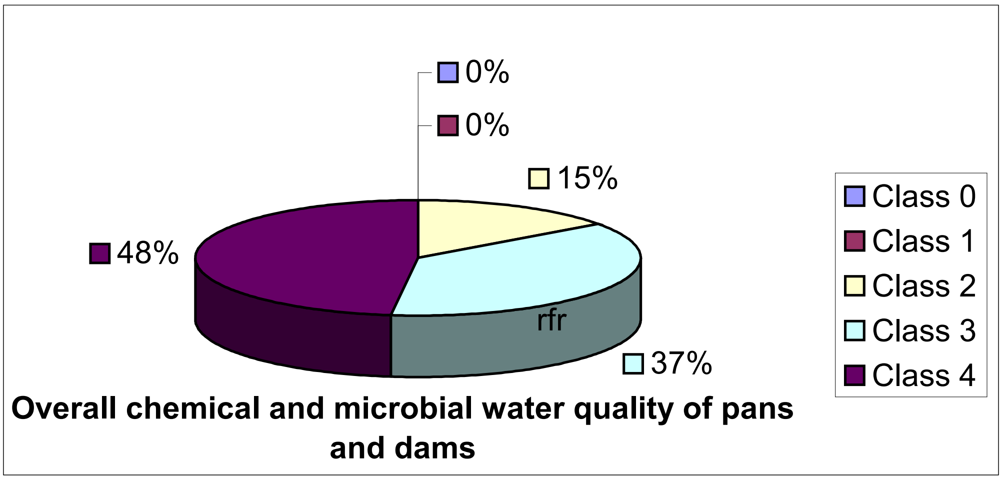

Figure 2: Overall Chemical and Microbial Water Quality of Pans and Dams.

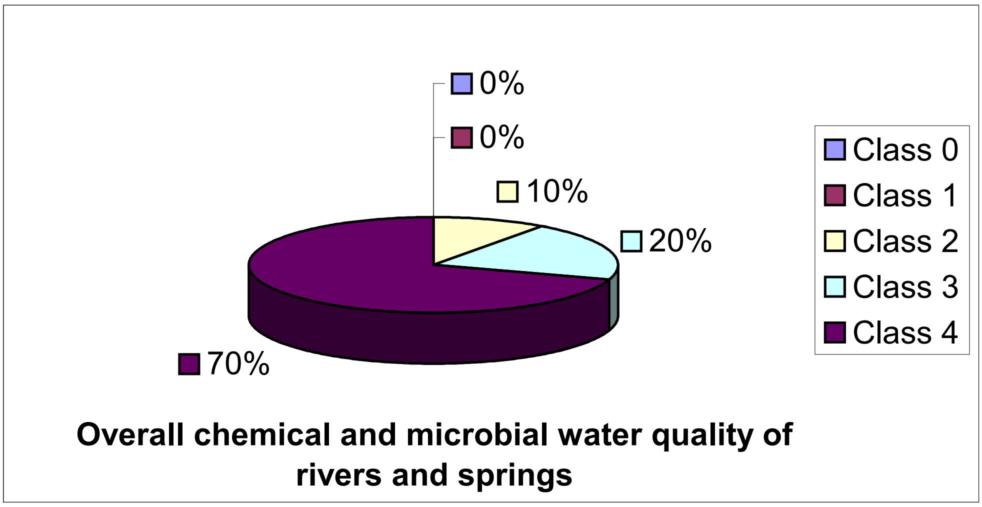

Figure 3: Overall Chemical and Microbial Water Quality of Rivers and Springs

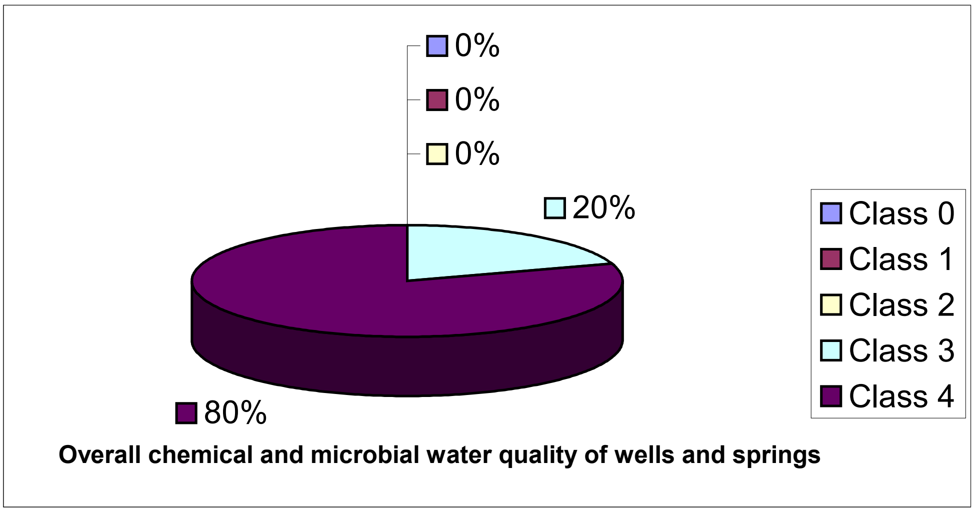

Figure 4: Overall Chemical and Microbial Water Quality of Wells and Springs

CHAPTER 5

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

- **Intersectoral Cooperation**

The pilot study confirmed that the intersectoral cooperation played a key role in the planning and operation of water quality surveillance programmes. The interest and support by all role players that participated in the study indicated that it would be possible to create the necessary intersectoral structures to operate surveillance programmes in a coordinated and integrated way. Advantages of intersectoral cooperation are the creation of a common understanding by the role-players of the water quality problems experienced by communities and opportunities to solve water quality problems in a much more holistic way. Duplication of programmes is thereby avoided and scarce funds and other resources are utilized much more efficiently. However, programmes will have to be carefully designed and the objectives of each of the role players will have to be stated clearly in order to avoid a "game keeper" and "poacher" situation. This success story can be expanded to include other institutions of higher learning nationally who are involved in water-related research.

- **Guidelines and Procedures**

The current joint initiative by the Department of Water Affairs and Forestry and the Department of Health, with the assistance of other major role-players in the water field, such as the Water Research Commission, Umgeni Water and Rand Water, to develop user-friendly guidelines and procedures for the monitoring and assessment of the health-related quality of water supplies, should be accelerated.

- **Water Quality Problems**

Faecal pollution in surface water was wide-spread throughout the district. Faecal pollution of rivers (70 percent), dams and pans (48 percent), springs and wells (80 percent) compared to boreholes (33 percent) gives an indication of microbial pollution that can cause diarrhoea that would afflict the health of communities if intervention strategies are not implemented. This situation poses a serious health risk to users who are, in many instances, using the water without any treatment. The majority of communities are dependant on these, as there are no other sources. The protection around most springs and boreholes, especially those with high faecal coliform counts, was found to be inadequate in most water sources. Cattle and pigs also utilize the same source for drinking.

5.2. Recommendations

- It is recommended that urgent attention be given to providing alternative water sources for domestic potable use.

- Water sources must be fenced in to protect water from being contaminated by domestic animals.

- The use of the sun and sedimentation as short-term water treatments are strongly recommended, irrespective of the season, because the results for seasonal variation sampling showed that seasonal changes had little effect on the overall water quality. With these methods of water treatment there are no financial costs involved. However, these methods can pose certain problems at times e.g. when it is cloudy or in winter and, in the case of sedimentation, when people cannot afford to wait for days before using water.

- Industrial bleach and boiling are also recommended to disinfect water collected from faecally polluted water sources. However, in terms of financial costs, communities reported that they could not afford to buy bleach and women could not afford to use firewood for boiling - the firewood had to be used for cooking.

- Because the above recommendations are for short-term use and pose a problem at times, appropriate water treatment plants should be considered as a long-term solution.

- To be cost-effective and sustainable, local communities themselves must be trained to operate simple treatment facilities.

- Communities must be informed about the quality of their water sources. Such information will enable them to make informed decisions regarding the correct use of available water.

- Findings of this research to be used in workshops nationally to give an indication of how this research was done and to educate people on capacity building.

- It is essential when planning future water quality surveillance programmes to uniquely identify all water sources used for domestic water supplies in rural areas. A unique and permanent source identification number (source ID e.g. H No. or ZQC No.) for every sampling point (boreholes and springs only) is essential for future and data recording purposes. This number must be cemented in at the sampling point or posted to each source and placed in a prominent position. Reference to it should be compulsory each time a sampler or researcher visits the source for monitoring purposes.

5.3 Research Products and Target Groups

Four broad dimensions of PROWATER HEALTH were of crucial importance in this process:

- To heighten awareness among the provincial government and the local communities of the need for water quality surveillance and control;
- To cooperate with relevant government departments (health, public works) in the establishment of surveillance and all that such establishment implies e.g. training, technology creation and supplies, reporting mechanisms and the invitation of the corrective mechanisms at the community level, whenever necessary;
- The development and dissemination to local communities of approaches and techniques appropriate for the currently non-existent infrastructure in the rural and peri-urban areas of the Eastern Cape; and
- The training of the technical staff of regional and local authorities responsible for water quality.

The project concentrated on the quality-related water development problems of the small and isolated settlements, the communities farming at subsistence level, the surplus-producing agricultural communities, the rural market towns, and peri-urban areas of the Eastern Cape, for example shanty towns.

Major practical applications include the following:

- Careful planning for surveillance and control of water quality, e.g. building of reservoirs to cater for the dry season, including the design of a workable organizational structure, the assessment of local conditions and the proper handling and use of information;
- The setting-up of sanitary inspection teams at local and regional level;
- Carrying out immediate remedial measures as well as long-term and short-term preventive action for achieving the desired control of drinking water quality.

In order to achieve the above-listed practical applications of PROWATER HEALTH, community education and involvement are prerequisite components upon which an effective surveillance programme must be built. The active participation of stake-holders in the community is considered a mandatory mechanism in safeguarding water quality, particularly in remote areas with small and scattered local settlements. It is envisaged that much of the local health education will be implemented within the framework of primary health care.

Bearing in mind the complexity of the infrastructure required, surveillance responsibilities ought to be shared and coordinated between water supply agencies, e.g. Mvula Trust and other NGO’s, public works and health authorities.

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APPENDICES

APPENDIX A

Table 6: Classification of Key constituents used to assess the health-related quality of water supplies

CONSTITUENT	UNITS	CLASS 0	CLASS 1	CLASS 2	CLASS 3	CLASS 4
Microbiological quality						> 100
Faecal coliforms	counts/100ml	0	0 – 1	1- 10	10 - 100	
Physical quality						>520
Electrical conductivity (EC)	mS/m	<70	70 - 150	150 – 370	370 -520	< 3..711
PH	pH units	5 - 9.5	4.5-5or9.5- 10	4 –4.5 or 10 – 10.5	3- 4 or 10.5 - 11	> 2.0
Chemical quality						> 0.050
Arsenic (As)	mg/l	< 0.010	0.010 - 0.050	0.050 - 0.2	0.2 –2.0	1200
Cadmium (Cd)	mg/l	< 0.003	0.003 - 0.005	0.005 - 0.020	0.02 – 0.050	> 1200
Chloride (Cl)	mg/l	< 100	100 – 200	200 – 600	600 – 1200	> 3.5
Fluoride (F)	mg/l	< 0.7	0.7 - 1.0	1.0 – 1..5	1.5 - 3.5	> 10.0
Iron (Fe)	mg/l	<0.01-0.5	0.5 - 1.0	1.0 – 5.0	5.0 – 10.0	>400
Magnesium (Mg)	mg/l	< 30-70	70 – 100	100 – 200	200 –400	>10.0
Manganese (Mn)	mg/l	<0.05-0.1	0.10- 0.4	0.4 – 4..0	4.0 –10.0	> 500
Potassium (K)	mg/l	<25	25-50	50 – 100	100 - 500	> 40
Nitrate plus nitrite as N (NO_3+ NO_2 as N)	mg/l	< 6	6 – 10	10 – 20	20- 40	> 1000
Sodium (Na)	mg/l	< 100	100 - 200	200 – 400	400 – 1000	>1000
Sulphate (SO_4)	mg/l	<100-200	200 - 400	400 – 600	> 600 – 1000	>1000
Zinc (Zn)	mg/l	< 3.0-20	>20			

(WRC, 1996)

APPENDIX B

Table 7: Classified results in the Peddie District for seasonal variations

Seq. No.	Village	Source *	Sample Date	FC/100 ml	Na mg/l	K mg/l	Mg mg/l	pH	Ec mS/M	Cl mg/l	SO_4 mg/l	F mg/l	NO_3 mg /l	Mn mg/l	Fe mg/l	Zn mg/l	As mg/l	Cd mg/l	Overall
13	Mphekweni	S	18/08/98		**334**				**234**	**551**							<0.003	<0.005	2
18	Mthathi Masango	P	18/08/98	**90**	**101**					**153**					**1.901**		<0.003	<0.005	3
15	Mtathi Mbokotwana	R	18/08/98		**309**				**185**	**488**		**0.8**					<0.003	<0.005	2
37	Ngqowa Esiginqini	R	18/08/98	**10**	**626**	**3.6**	**112**	**3**	**459**	**1226**			**7.03**				<0.003	<0.005	4
14	Ngqowa Mkhanyeni	P	18/08/98		**275**				**161**	**509**				**0.524**			<0.003	<0.005	2
64	Nobumba	S	18/08/98		**722**		**134**		**458**	**1310**	**240**	**0.7**	**56.59**				<0.003	<0.005	4
55	Ntloko	F	18/08/98	**880**					**261**	**598**		**1**	**26.86**				<0.003	<0.005	4
33	Ntsamanzi	P	18/08/98	**1970**	**211**				**164**	**351**				**1.025**	**1.128**		<0.003	<0.005	4
28	Ntsamanzi Mabaleni	F	19/08/98		**455**				**288**	**652**		**0.8**					<0.003	<0.005	3
52	Nyeleni	B	19/08/98		**727**	**29.2**	**16**		**458**	**1009**		**0.8**	**56.73**		**0.761**		<0.003	<0.005	4
53	Nyeleni	R	19/08/98		**283**				**250**	**489**		**1**					<0.003	<0.005	2
40	Tuba	S	19/08/98	**1**	**623**	**59.7**	**85**		**413**	**952**		**1.3**	**29.2**				<0.003	<0.005	3
47	Upper Gwala	P	19/08/98	**130**	**391**				**190**	**461**	**129**	**0.3**	**0.07**	**0.314**			<0.003	<0.005	4

KEY:					
Ideal for potable use	0	Suitable for potable use	1	Conditionally acceptable for potable use	2
Unsuitable for potable use	3	Totally unsuitable for potable use	4		

B = Borehole ; F = Spring ; P = Dam ; R = River ; FC = Faecal Coliform
(WRC, 1996)

APPENDIX C
Table 8: Classified results in the Peddie District

Seq. No	Latitude	Longitude	Village	Soutce	Sample Date	FC/ 100ml	Na mg/l	K mg/l	Mg mg/l	pH	EC mS/M	Cl mg/l	SO_4 mg/l	F mg/l	NO_3 mg/l	Mn mg/l	Fe mg/l	Zn mg/l	As mg/l	Cd mg/l	Overall Class
5	33 22 58	27 11 59	Benton	B	19/08/97	0	208	44.70	34	8.30	134	291	58	0.50	1.06	<0.001	<0.003	<0.003	<0.050	<0.001	2
8	33 22 48	27 12 04	Benton	P	19/08/97	320	67	3.50	8	8.40	39.90	57	30	0.50	1.01	0.100	11.00	<0.003	<0.050	<0.001	3
48	33 18 59	27 11 10	Binqala	R	19/08/97	0	193	5.30	35	7.90	150	366	33	0.20	<,0.10	<0.001	<0.003	<0.003	<0.050	<0.001	2
45	33 19 14	27 11 48	Binqala	P	19/08/97	80-	93	5.50	14	8.20	65.50	131	52	0.20	1.78	0.100	2.000	0.500	<0.050	<0.001	3
57	33 16 49	27 08 21	Celetyuma	P	19/08/97	210	46	4.60	6	8.10	33.20	55	42	0.20	0.10	<0.001	1.000	<0.003	<0.050	<0.001	3
58	33 16 31	27 17 18	Celetyuma	P	19/08/97	0	103	3.10	20	8.20	72.20	146	42	0.20	0.28	<0.001	1.000	<0.003	<0.050	<0.001	2
75	33 10 37	27 17 14	Crossroads	B	20/08/97	0	397	9.40	84	7.80	275	705	77	0.60	9.07	<0.001	<0.003	0.200	<0.050	<0.001	3
74	33 10 40	27 19 21	Crossroads	P	20/08/97	0	56	8.40	10	8.0.	44	52	41	0.30	0.11	<0.001	1.000	<0.003	<0.050	<0.001	2
73	33 11 49	27 07 02	Leqeni	P	20/08/97	10	64	5.70	11	8.0	51	107	27	0.10	0.12	<0.001	1.000	<0.003	<0.050	<0.001	3
56	33 16 54	27 06 44	Mgwalama (Upper)	P	21/08/97	80	38	5.80	6	8.0	28.20	32	37	0.20	0.10		8.000	<0.003	<0.050	<0.001	3
60	33 16 16	27 07 02	Mgwalama	B	21/08/97	0	560	4.50	143	8.0	421	1166	128	0.20	<0.10	0.100	<0.003	0.500	<0.050	<0.001	3
59	3 316 21	27 06 28	Mgwalama	P	21/08/97	30	189	3.30	28	8.40	125.80	279	58	0.30	1.74	<0.001	<0.003	<0.003	<0.050	<0.001	3
4	33 23 20	27 08 54	Ngqowa-Mkhanyeni	P	04/02/97	1940	35	18.20	8	8.10	36.10	43	24	0.30	1.74	0.100	2.503	0.100	<0.050	<0.001	3
6	33 22 55	27 08 11	Ngqowa-Mkhanyeni	P	04/02/97	240	134	8.10	20	8.90	100.70	204	57	0.50	3.77	0.139	0.874	0.135	<0.050	<0.001	3
7	33 22 50	27 07 43	Ngqowa-Mkhanyeni	P	04/02/97	2000	56	8.50	9	8.00	47.80	85	24	0.30	1.02	0.058	0.939	0.095	<0.050	<0.001	3
9	33 22 44	27 07 09	Ngqowa-Mkhanyeni	P	04/02/97	360	47	3.40	5	7.90	34.50	59	19	0.20	0.35	0.044	0.814	0.027	<0.050	<0.001	3
14	33 22 33	27 07 12	Ngqowa-Mkhanyeni	P	04/02/97	430	45	8.60	7	7.80	39.40	74	17	0.20	1.44	0.134	4.524	0.143	<0.050	<0.001	3

KEY:	Ideal for potable use	0	Suitable for potable use	1	Suitable for short-term potable use	2	Unsuitable for potable use	3

B = Borehole ; F = Spring ; P = Dam ; R = River ; FC = Faecal Coliform
(WRC, 1996)

APPENDIX C Continued…

Table 9: Classified results in the Peddie District

Seq. No	Latitude	Longitude	Village	Soutce	Sample Date	FC/ 100ml	Na mg/l	K mg/l	Mg mg/l	pH	EC mS/M	Cl mg/l	SO_4 mg/l	F mg/l	NO_3 mg/l	Mn mg/l	Fe mg/l	Zn mg/l	As mg/l	Cd mg/l	Overall Class
13	33 22 34	27 06 18	Mphekweni	B	04/02/97	50	847	8.10	134	8.10	513.00	1647	170.	0.60	3.98	<0.001	<0.003	0.168	<0.050	<0.001	3
17	33 22 19	27 06 19	Mphekweni	P	05/02/97	1490	37	2.90	4	8.30	26.70	25	24.	0.40	2.66	0.400	27.000	0.100	<0.050	<0.001	3
11	33 22 37	27 05 36	Mphekweni	B	05/02/97	910	72	3.30	12	8.10	57.80	102	17	0.30	0.21	0.500	0.065	2.200	<0.050	<0.001	3
10	33 22 42	27 04 46	Mphekweni	P	05/02/97	1600	90	4.10	8	8.20	59.10	123	22	0.20	0.17	0.100	2.000	0.100	<0.050	<0.001	3
20	33 21 54	27 05 03	Mthaathi-Komkulu	P	06/02/97	40	79	2.70	7	9.40	48.20	33	20	0.70	<0.10	0.039	0.527	0.039	<0.050	<0.001	3
19	33 22 03	27 05 00	Mthaathi-Komkulu	P	06/02/97	10	35	2.30	6	8.30	28.90	24	11	0.40	<0.10	<0.001	0.235	0.098	<0.050	<0.001	3
16	33 22 25	27 03 45	Mthathii	P	06/02/97	1000	48	2.10	5	7.80	36.40	77	19	0.20	0.15	0.007	1.894	0/026	<0.050	<0.001	3
15	33 22 31	27 032 26	Mthathii-Mbokotwana	R	06/02/97	360	401	7.20	66	8.30	286.00	672	102	0.80	3.06	0.009	0.222	0.219	<0.050	<0.001	3
12	33 22 36	27 02 00	Mthathii-Mbokotwana	P	06/02/97	480	138	5.20	16	8.30	87.00	205	17	0.30	<0.10	0.026	0.062	0.033	<0.050	<0.001	3
18	33 22 05	27 03 37	Mthathii-Masango	P	06/02/97	800	630	10.60	76	8.50	395	1138	135	0.90	0.20	<0.001	0.117	<0.003	<0.050	<0.001	3
38	33 20 41	27 03 46	Newtondale	P	07/02/97	200	48	6.10	6	7.80	36.80	77	12	.020	<0.10	0.027	0.227	0.039	<0.050	<0.001	3
61	33 16 03	27 02 16	Nobumba	B	21/08/97	0	511	3.40	103	7.90	338.00	917	188	1.20	3.63	<0.001	<0.003	0.100	<0.050	<0.001	3
64	33 15 45	27 02 23	Nobumba	B	21/08/97	0	774	18.20	178	7.90	546.00	1406	221	0.80	134	<0.001	<0.003	0.400	<0.050	<0.001	3
55	33 17 35	27 03 35	Ntoko	F	21/08/97	7	316	8.90	56	7.90	211.00	528	81	0.90	21.09	<0.001	<0.003	<0.003	<0.050	<0.001	3
51	33 18 20	27 03 56	Ntokoo	P	21/08/97	0	76	7.60	8	7.80	52.60	110	37	0.10	0.23	<0.001	1.000	<0.003	<0.050	<0.001	2
22	33 21 36	27 01 22	Nthamanzi-Mabaleni	P	06/02/97	260	79	7.30	13	8.20	52.60	137	29	0.20	1.05	0.009	0.248	0.071	<0.050	<0.001	3
28	33 21 27	27 02 05	Nthamanzi-Mabaleni	F	06/02/97	750	116	6.90	22	8.10	91.50	214	16	0.20	<0.10	0.231	1.395	0.102	<0.050	<0.001	3
32	33 21 07	27 01 45	Nthamanzi-	R	06/02/97	1520	361	8.10	67	8.10	256.00	641	70	0.70	1.67	0.092	0.106	0.098	<0.050	<0.001	3

KEY:	Ideal for potable use	0	Suitable for potable use	1	Suitable for short-term potable use	2	Unsuitable for potable use	3

B = Borehole ; F = Spring ; P = Dam ; R = River ; FC = Faecal Coliform
(WRC, 1996)

APPENDIX C Continued…
Table 10: Classified results in the Peddie District

Seq. No	Latitude	Longitude	Village	Soutce	Sample Date	FC/ 100ml	Na mg/l	K mg/l	Mg mg/l	pH	EC mS/M	Cl mg/l	SO_4 mg/l	F mg/l	NO_3 mg/l	Mn mg/l	Fe mg/l	Zn mg/l	As mg/l	Cd mg/l	Overall Class
27	33 21 27	27 02 16	Ntshamanzi-Mabaleni	F	06/02/97	1310	232	3.40	31	8.20	162.00	333	62	0.70	1.79	0.048	0.136	0.107	<0.050	<0.001	3
21	33 21 39	27 02 26	Ntshamanzi-Mabaleni	R	06/02/97	200	536	10.20	44	8.60	272.00	747	96	0.90	<0.10	0.019	0.486	0.105	<0.050	<0.001	3
39	33 20 27	27 01 13	Ntshamanzi	P	06/02/97	870	86	25.00	11	8.00	70.20	125	43	0.30	1.33	0.222	15.830	0.151	<0.050	<0.001	3
25	33 21 29	27 03 09	Ntshamanzi	B	07/02/97	0	355	5.50	74	7.50	286.00	737	107	0.70	8.87	0.091	0.518	1.646	<0.050	<0.001	3
33	33 21 02	27 01 17	Ntshamanzi	P	06/02/97	5140	66	11.30	9	8.20	48.40	85	28	0.30	0.73	0.136	0.587	0.056	<0.050	<0.001	3
29	33 21 32	27 00 58	Ntshamanzi	P	06/02/97	4480	53	9.60	9	8.20	39.80	64	20	0.40	0.10	0.156	6.799	0.057	<0.050	<0.001	3
24	33 21 32	27 00 34	Ntshamanzi	F	06/02/97	3580	253	4.60	40	7.80	179.00	402	53	0.40	0.17	0.136	0.197	0.086	<0.050	<0.001	3
31	33 21 10	27 01 09	Ntshamanzi	F	06/02/97	7420	218	3.90	41	8.10	170.00	326	61	0.70	3.56	0.068	0.033	0.099	<0.050	<0.001	3
69	33 14 13	27 08 01	Nyaniso	P	18/08/97	100	137	2.80	14	8.30	87.50	207	39	0.20	0.31	<0.001	4.000	<0.003	<0.050	<0.001	3
68	33 13 53	27 08 07	Nyaniso	P	18/08/97	290	56	1.10	13	7.70	44.90	79	11	0.20	<0.10	<0.001	<0.003	0.200	<0.050	<0.001	3
71	33 13 49	27 07 35	Nyeleni	P	18/08/97	10	54	2.30	6	8.30	31.60	20	19	0.40	O.12	0.100	7.000	<0.003	<0.050	<0.001	3
54	33 17 45	27 07 51	Nyeleni	R	04/02/97	22	273	3.80	59	8.20	225.00	491	66	0.50	0.13	<0.001	0.046	0.011	<0.050	<0.001	3
52	33 18 16	27 07 29	Nyeleni	B	04/02/97	0	690	27.00	72	8.10	426.00	982	120	0.80	56.68	<0.001	0.108	0.817	<0.050	<0.001	3
50	33 18 39	27 06 19	Nyeleni	P	04/02/97	0	59	4.90	9	8.10	41.90	58	10	0.60	<0.10	0.046	0.268	0.095	<0.050	<0.001	2
53	33 18 09	27 06 58	Nyeleni	R	04/02/97	280	392	5.10	39	8.10	245.00	469	121	1.10	3.32	<0.001	0.043	0.093	<0.050	<0.001	3
1	33 24 16	27 07 25	Prudhoe	B	05/02/97	0	316	9.30	63	7.90	236.00	562	80	0.80	<0.10	0.138	0.041	0.246	<0.050	<0.001	2
46	33 19 12	27 05 59	Oeto	B	03/02/97	0	424	4.60	61	8.30	289.00	757	62	1.10	7.17	<0.001	0.061	0.163	<0.050	<0.001	3
43	33 19 37	27 05 40	Oeto	P	03/02/97	4	32	1.40	4	8.40	21.40	18	16	0.50	0.63	0.037	0.778	0.043	<0.050	<0.001	2

KEY:	Ideal for potable use	0	Suitable for potable use	1	Suitable for short-term potable use	2	Unsuitable for potable use	3

B = Borehole ; F = Spring ; P = Dam ; R = River ; FC = Faecal Coliform
(WRC, 1996)

APPENDIX C Continued…
Table 11: Classified results in the Peddie District

Seq. No	Latitude	Longitude	Village	Soutce	Sample Date	FC/ 100ml	Na mg/l	K mg/l	Mg mg/l	pH	EC mS/M	Cl mg/l	SO_4 mg/l	F mg/l	NO_3 mg/l	Mn mg/l	Fe mg/l	Zn mg/l	As mg/l	Cd mg/l	Overall Class
34	33 20 56	27 07 10	Nqowa-Esiginqini	R	04/02/97	180	442	5.30	57	8.60	291.00	763	54	1.00	0.21	<0.001	0.056	0.065	<0.050	<0.001	3
35	33 20 56	27 06 49	Nqowa-Esiginqini	B	04/02/97	39	306	2.60	50	8.30	223.00	455	64	0.70	9.36	<0.001	0.131	0.161	<0.050	<0.001	3
36	33 20 49	27 06 52	Nqowa-Esiginqini	R	04/02/97	410	480	7.60	61	8.40	312.00	873	64	0.40	0.24	<0.001	<0.003	0.081	<0.050	<0.001	3
30	33 21 10	27 07 57	Nqowa-	R	04/02/97	0	514	5.40	52	8.50	317.00	801	74	0.70	0.25	<0.001	0.023	0.078	<0.050	<0.001	3
23	33 21 33	27 08 56	Nqowa-Esiginqini	B	04/02/97	89	648	8.60	81	7.90	424.00	1047	113	1.60	11.97	<0.001	0.064	1.654	<0.050	<0.001	3
37	33 20 48	27 06 17	Nqowa-Esiginqini	R	04/02/97	150	593	4.50	100	8.10	423.00	1196	104	0.40	5.70	<0.001	<0.003	0.089	<0.050	<0.001	3
26	33 21 27	27 14 22	Tharfieldi	B	19/08/97	0	216	4.80	37	8.10	160.00	295	63	0.50	0.68	<0.001	<0.003	<0.003	<0.050	<0.001	2
40	33 20 02	27 09 24	Tuba	B	19/08/97	0	717	61.50	89	8.10	400.00	1072	137	1.20	35.73	<0.001	<0.003	<0.003	<0.050	<0.001	3
41	33 19 41	27 09 14	Tuba	B	19/08/97	0	787	6.40	84	7.70	431.00	1141	179	0.70	1.82	<0.001	2.000	2.200	<0.050	<0.001	3
42	33 19 39	27 09 13	Tuba	P	19/08/97	20	89	2.70	12	7.90	57.10	136	40	0.20	0.34	<0.001	4.000	<0.003	<0.050	<0.001	3
72	33 13 17	27 18 38	Tuku A	P	20/08/97	10	19	2.50	3	7.70	15.20	20	24	0.10	0.34	<0.001	3.000	<0.003	<0.050	<0.001	3
70	33 14 02	27 19 07	Tuku A	P	20/08/97	0	104	2.40	12	8.10	62.40	135	26	0.20	1.49	<0.001	1.000	<0.003	<0.050	<0.001	2
63	33 15 45	27 19 06	Tuku C	P	20/08/97	20	140	6.00	18	8.20	94.90	226	31	0.20	0.59	0.100	2.000	<0.003	<0.050	<0.001	3
65	33 14 30	27 17 36	Tuku B	P	20/08/97	10	100	8.40	15	8.20	62.80	142	35	0.20	2.41	<0.001	3.000	<0.003	<0.050	<0.001	3
47	33 19 05	27 03 43	Upper Gwalana	P	07/02/97	1600	108	5.30	20	8.20	84.80	183	43	0.20	2.48	0.012	0.214	0.108	<0.050	<0.001	3
44	33 19 17	27 04 00	Upper Gwalana	P	07/02/97	20	151	3.50	22	8.40	113.60	250	38	1.40	0.41	0.019	0.812	0.094	<0.050	<0.001	3
49	33 18 56	27 04 49	Upper Gwalana	P	07/02/97	0	126	5.40	21	8.30	95.90	201	37	0.30	2.15	0.075	1.273	0.115	<0.050	<0.001	2
62	33 15 50	27 03 30	Woodlands	B	18/08/97	0	1456	24.60	162	8.30	757.00	2213	333	1.40	0.61	<0.001	<0.003	0.400	<0.050	<0.001	3
66	33 15 13	27 03 42	Woodlands	P	18/08/97	130	809	39.60	141	9.60	526.00	1662	160	0.30	0.81	<0.001	<0.003	<0.003	<0.050	<0.001	3
67	33 15 10	27 03 17	Woodlands	P	18/08/97	0	335	14.70	74	9.30	243.00	719	61	0.30	<0.10	<0.001	<0.003	<0.003	<0.050	<0.001	3
2	33 23 59	27 05 47	Zweledinga	B	05/08/97	0	449	3.00	43	8.10	255.00	651	83	0.50	<0.10	0.119	64.200	8.390	<0.050	<0.001	3
3	33 23 53	27 04 34	Zweledinga	P	05/08/97	80	70	2.00	9	8.30	48.90	94	17	0.30	0.12	<0.001	0.286	0.100	<0.050	<0.001	3

KEY:	Ideal for potable use	0	Suitable for potable use	1	Suitable for short-term potable use	2	Unsuitable for potable use	3

B = Borehole ; F = Spring ; P = Dam ; R = River ; FC = Faecal Coliform
(WRC, 1996)

APPENDIX D

HEALTH-RELATED WATER QUALITY AND SURVEILLANCE PROGRAMME IN THE PEDDIE DISTRICT IN THE EASTERN CAPE

REPORT BACK ON RESEARCH RESULTS TO COMMUNITIES IN JULY 1998

(This report was prepared according to the Assessment Guide for 1996 because the one for 1998 was still under consideration).

Introduction

During the last visit to the communities in 1997, a sample of water was taken from the water sources as used by the villagers. The main reason for doing this was to take the sample to a reputable scientist for analyses in order to ascertain whether or not it was fit for human consumption.

This then is the report on the results of the analyses regarding the quality of the water.

It is a well-known fact that water is life. In people's homes, water is used as follows:

1. **FOOD AND DRINK** – For drinking purposes and for cooking food .

2. **CLEANLINESS** – Water is used to cleanse the body of bacteria; for washing eating utensils; for washing clothes; for washing linen and for cleaning homes. It is clear that the water used as described must be of suitable quality.

3. **WHICH QUALITY OF WATER IS THE MOST SUITABLE?**
   According to a scientist, the quality of water can be categorised into the following four categories:

   Category 0, Category 1, Category 2 and Category 3. The categories differ in quantity of bacteria found in water.

   Category 0: This is good quality water, which can be used for anything and which is not detrimental to the health of the user.

   Category 1: In this category the water is of suitable quality, and can be used for many things, with little or no harmful effects.

   Category 2: Water in this category is not that harmful when used for short periods. However, when water of this quality is used for longer periods, the user is putting his/ her life in danger.

   Category 3: The quality of water in this category is very dangerous - more than any other category - and will detrimentally affect the health of small children and the aged. This category of water is, therefore, totally unsuitable for human consumption.

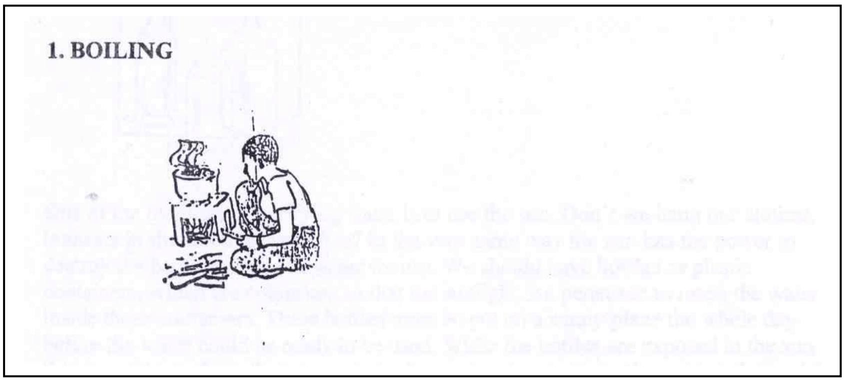
4. HOW TO RATE THE WATER?

The results of the analyses of the water carried out by the scientist mentioned in the **Introduction** above, indicated that the water fell under category 2 and category 3. There are, nevertheless, many ways in which to treat water. The most important aspect is that there is enough water available at present, but various methods for treating the sources to make it fit for human consumption, are now needed.

5. WAYS OF WATER TREATMENT

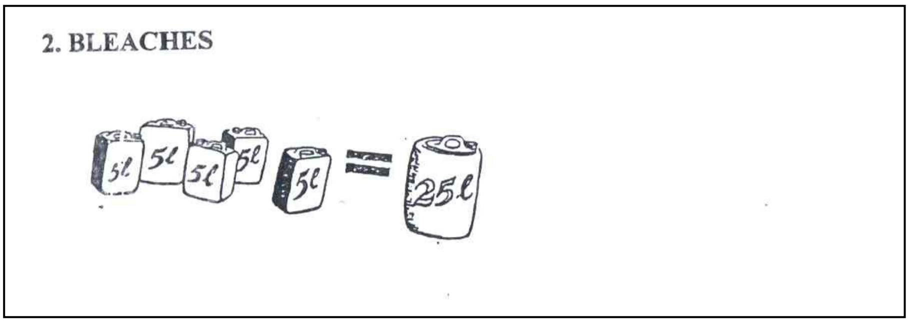
There are many ways in which to treat water, the following of which are just a few:

1. BOILING



To boil water on fire kills the bacteria that may cause diseases like diarrhoea. Water should be boiled on a fire for about one minute. When it cools down or even when it is cold, water can be kept in clean utensils which must be sealed so as to prevent any bacterial contamination. To avoid contamination by bacteria present on the hands, utensils with handles must always be used when extracting water from the container.

2. BLEACHES



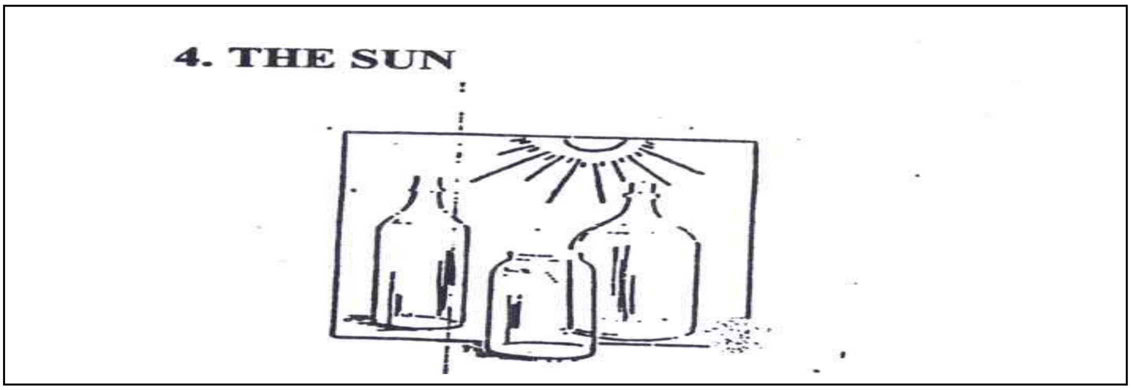
Using bleaches like **Jik** is one of the ways of water treatment. It is very important to strictly adhere to the correct dosage of Jik or any other bleach when treating water in this manner. For instance, in 20-25 liters of water, pour one teaspoon full of bleach. After four hours, this water can be used. ***Warning: Do not to use a perfumed bleach to treat drinking water – this will give the water a taste like soap.***

3. SEDIMENTATION

Sedimentation is one of oldest ways of purifying water. To use this method two (2) water buckets are required. The first bucket is filled with water and left undisturbed for 3 days. This will allow sediment and any impurities to settle at the bottom of the bucket. On the 4th day carefully pour only the clean water from the first bucket into the second bucket without disturbing the sediment.

The clean water can be used for cooking and the water containing the sediment can be used to water the garden, since it is rich in fertilizers.

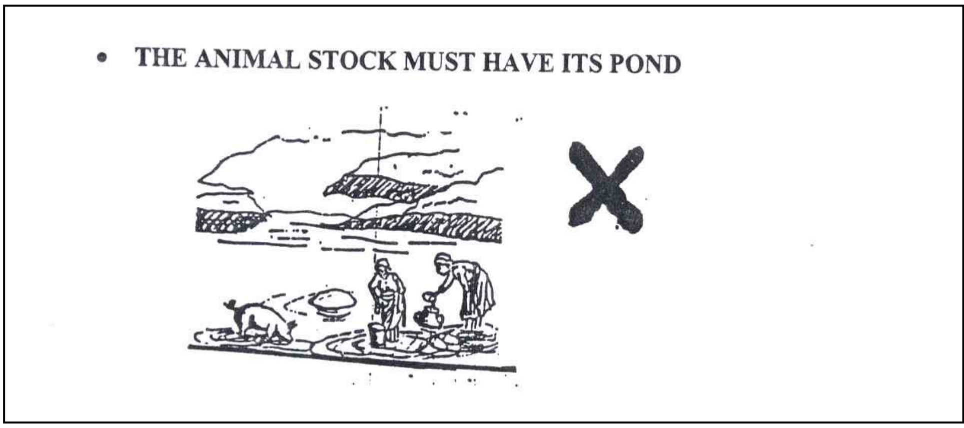
4. THE SUN



Another method used to purify water is to use the sun.
Clothes and blankets are hung out in the sun to destroy lice. In the very same way, the sun has the power to destroy the bacteria found in the water used. To purify water, bottles or plastic containers, which are colourless, can be used so that the sun's rays can penetrate the bottle or plastic container and reach the water inside. These bottles/containers must be placed in a sunny spot for a whole day before the water is ready to be used. Care must be taken that nothing is placed in front of the bottle/container that could prevent the sun's rays from reaching the water. Unfortunately, when it is cloudy, and the sun does not shine, this method does not work. Therefore, this method would then be the last one to try when the other methods have been unsuccessful.

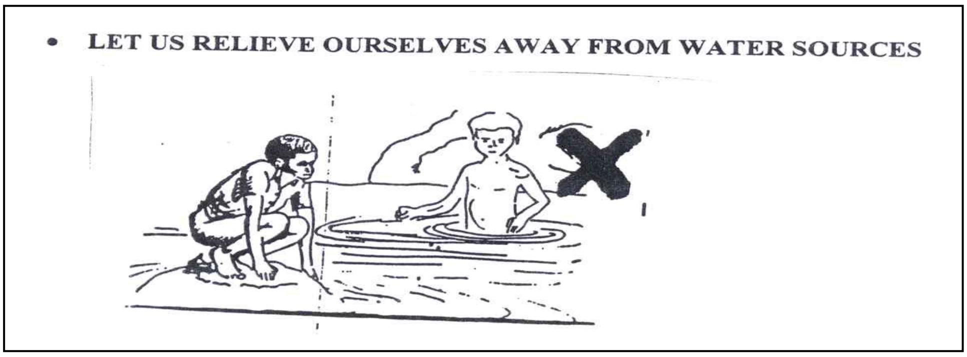
Here is some other advice in connection with caring for the sources from which water is drawn:

- **THE LIVESTOCK MUST HAVE THEIR OWN POND**

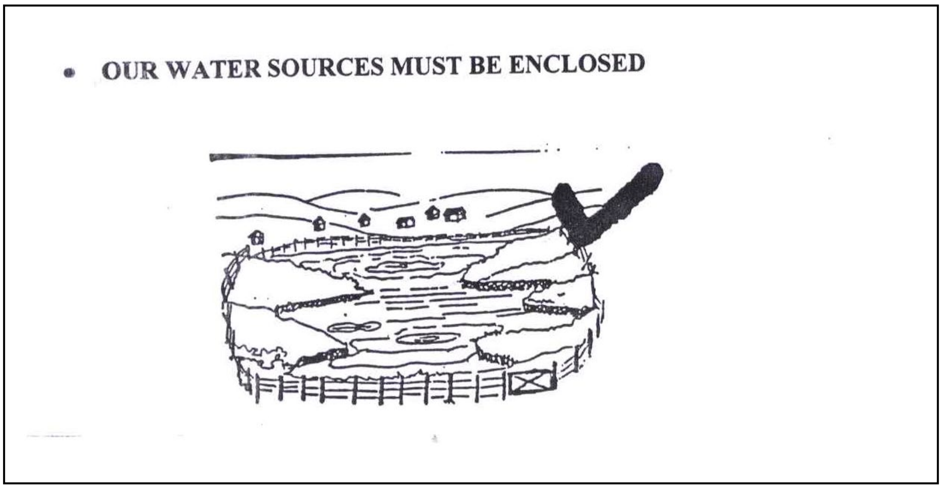


- **ES**

- **OUR WATER SOURCES MUST BE DISTANCED FROM OUR TOILET**



- **OUR WATER SOURCES MUST BE ENCLOSED**



RESPONSE FROM COMMUNITIES

Responses from all the communities were extremely positive. People were grateful to receive feedback on the results of the research done in their villages.

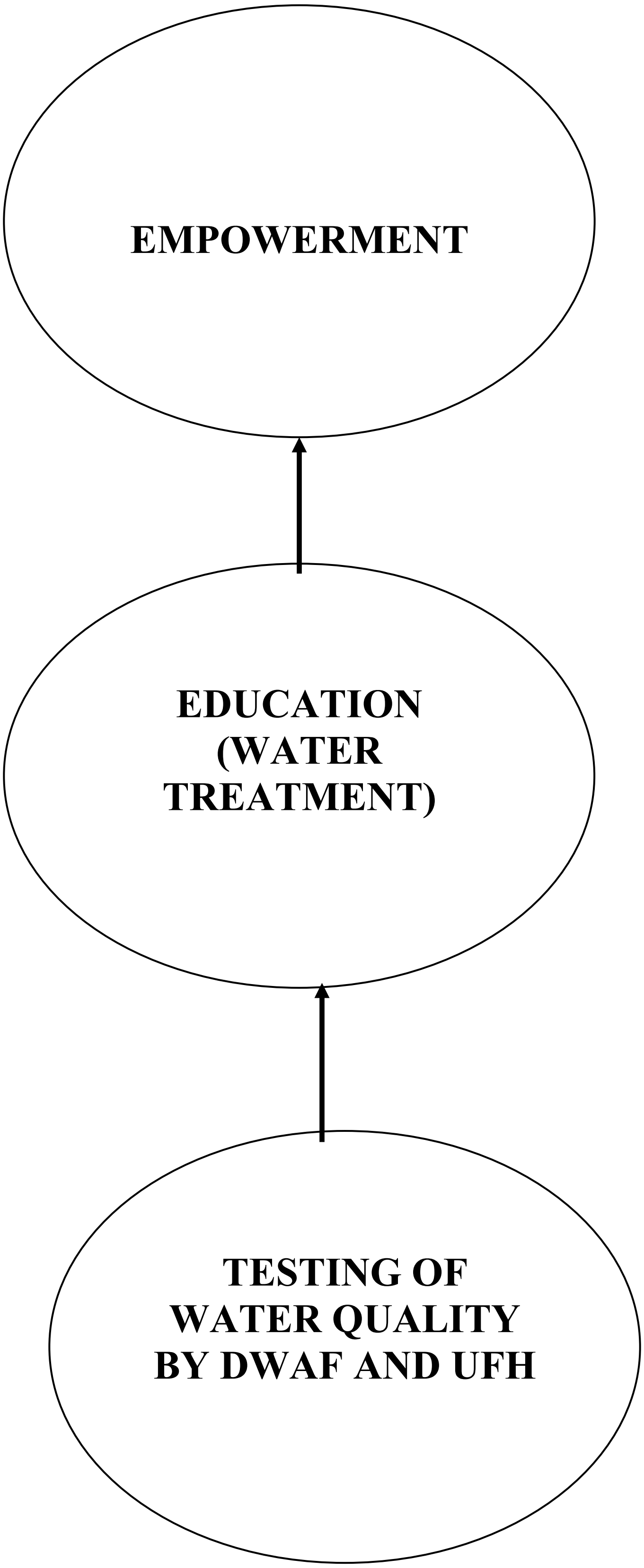
All the communities were aware that they were using water unsuitable for human consumption, but they had no alternative as the existing water sources are the only ones available. They also understand that sharing water with livestock is hazardous to their health and that livestock need to have a separate water source, e.g. a trough.

In some villages people reported that, although they had windmills, these had been broken for about two to three years and so they were compelled to use water from the dams.

It was also brought to the attention of the Research Team that certain people were taking advantage of the situation. These persons are aware of the plight of the communities and promise them clean water by means of installing sandpipes on receipt of a monetary contribution. Once the money has been paid these persons disappear and are never seen again.

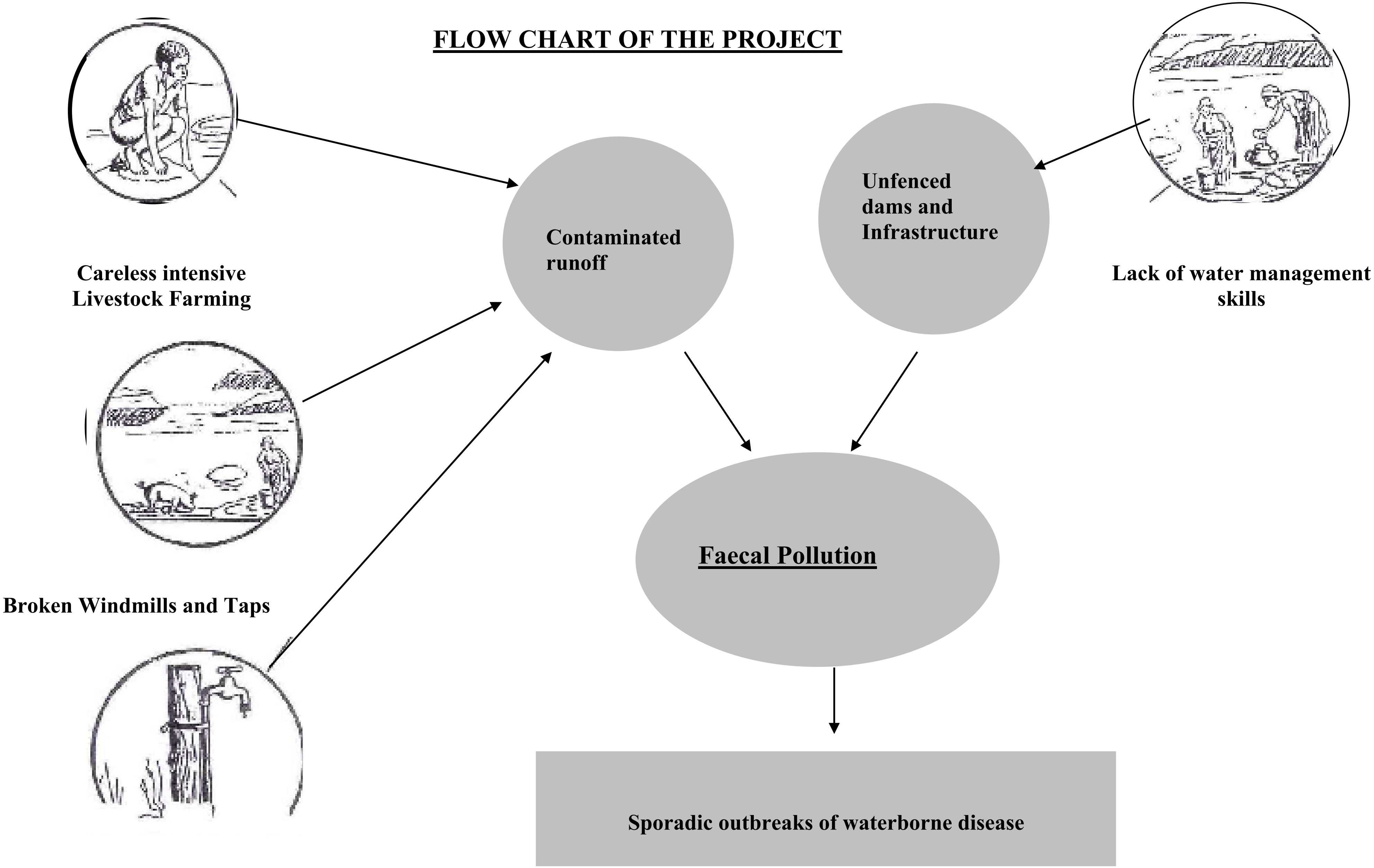
Communities requested copies of this Report as proof of the fact that their situation had been investigated and that it had been proved that they were using water unfit for human consumption. The Report would be used as a tool in lobbying the Government in urgently providing the much needed infrastructure for provision of clean water.

INTERVENTION BY THE STAKEHOLDERS



Lack of Sanitation

FLOW CHART OF THE PROJECT



Appendix E : Questionnaire

University of Fort Hare - Department of Development Studies

PROWATER HEALTH PROJECT

Survey of community and sanitation facilities, water quality and occurrence of waterborne diseases

Community number:			Date of survey	/ / 19
Name of organisation filling in this form:		Person filling in form:		Phone No:

Table B101: Location of Town/ Village/ Community

Name:	Regional Council:
Postal Address:	Trans.Regional Council:
	District Council:
	Tribal Authority:
	Administrative area:

Table B102: Management of Facilities

	Level of Management Provided					
	None	Show no interest	Lacking Capability			
			Technical	Managerial	Funding	Fully functional
Water Committee						
Tribal Authority						
District Council						
Trans. Regional Council						
Regional Council						
Water Board						

Table B103: Types of Systems

	Water	Sanitation
Regional Scheme	% of population	% of population
Local Scheme	% of population	% of population
Individual Supply	% of population	% of population

B200: WATER SUPPLY SERVICES

B201: DESIGN STANDARDS OF EXISTING SERVICES (RDP Guidelines)

Below minimum RDP levels	% of population
Meeting minimum RDP levels (Min RDP)	% of population
Exceeding minimum and medium RDP levels (Med RDP)	% of population
Households with individual connections, no waterborne sanitation (ConNoWat)	% of population
Households with individual connections with waterborne sanitation (ConWat)	% of population

B201: EXPLANATION OF RDP GUIDELINES

	Quantity of water available	Distance from water point	Sanitation system
Below RDP levels	Less than 25 liters per person per day	More than 200m from water	None
Min RDP	25 liters per person per day	Less than 20m from water	Other than waterborne
Med RDP	60 liters per person per day	Less than 200m from water	Other than waterborne
ConNoWat	Water connections to households	At home	Other than waterborne
ConWat	Water connections to households	At home	Waterborne sanitation

B202: EXISTING SOURCES, QUALITY AND USAGE (RDP,Guidelines)

No	Name	Type of source - see codes	Fit for human consumption Y/N	Quality - see codes	Used for other purposes			Reason source not used - see codes	Other community using source
					Irrigation	Livestock	Other		
1									
2									
3									
4									
5									
6									
7									

B202: SOURCE TYPE CODES

		Spring:	SPR	River:	RVR	Canal:	CNL
Well:	Well:	Borehole:	BRH	Dam:	DAM	Other:	OTH

B202: QUALITY CODES (Referring to Potability)

U	Unusable	M	Marginal	V	Very good	B	Brack
A	Stock only	G	Good	F	Fresh	S	Salty

B202: CODES FOR REASON SOURCE NOT USED

S	Source damaged	F	Infrastructure damaged	D	Source dry	O	Other

COMMENTS

B203: EXISTING INFRASTRUCTURE & ABILITY TO SERVE COMMUNITY AT BASIC MINIMUM STANDARD

No.	Type - see codes	Original design capacity		Existing capacity % of pop it can serve at RDP level	Infrastructure not used or fully utilised			Other community using infrastructure
		% of 1995 pop it can provide 25/day/person			Need repairs	Destroyed	Other reasons	
1								
2								
3								
4								
5								
6								

B203: CODES FOR TYPES PF INFRASTRUCURE

Pump	PMP	Reservoir	RSV
Purification plant	PUR	Reticulation	RET
Windmill	WM	Self-catering	SEL
Water carts	CRT	Vendors	VEN
Regional	REG		

COMMENTS

B204: CONNECTIONS

	% dwellings	Repair required
House connections		
Meters		

COMMENTS

B205: EXISTING STANDARDS OF SERVICES TO RESIDENTS (RDP Guidelines)

QUANTITATIVE SUPPLY (% Population)		DISTANCE TO SUPPLY (% Population)

0-10// cap/day	10-25// cap/ day		0-200m	200-500m	>500m
%	%		%	%	%

RELIABILITY & FLOW RATE

Supply is reliable (98 % of time)	Flow rate (> 10/ min)
% of pop	% of pop

COMMENTS

B 300: SANITATION SERVICES

B301: EXISTING SANITATION TYPES (RDP Guidelines)

Below RDP standard	At RDP standard	Above RDP standard
% of population	% of population	% of population

B301: EXPLANATION OF RDP GUIDELINES

Below RDP standard	No sanitation at all, buckets or unimproved pits
At RDP standard	Ventilated improved pits or double ventilated
Above RDP standard	Digesters, bucket systems, French drains, suction systems, small borehole systems or waterborne systems

COMMENTS

B302: TREATMENT WORKS

	No treatment	Primary (e.g. sedimentation)	Secondary (e.g. oxygen conversion)	Full effluent compliance
% of population served				

COMMENTS

B303: EXISTING STANDARDS OF SANITATION

	Health Risk	Environmental Risk	Functional deficiencies	

COMMENTS

400: COMMENTS

B401: ENVIRONMENTAL AND OTHER CONSTRAINTS ON SANITATION AND WATER

Reason for constraint	Water supply		Sanitation	
Geology: Shallow rock	Yes		Yes	
Soil: Clay	Yes		Yes	
Sand	Yes		Yes	
Surface water	Yes		Yes	
Geohydrology	Yes		Yes	
Flora	Yes		Yes	
River	Yes		Yes	
No water	Yes		Yes	
Other	Yes		Yes	

B402: MANAGEMENT/ INSTITUTIONAL CONSTRAINT

COMMENTS

B403: COMMUNITY ATTITUDES AND ABILITY

	Attitudes				Potential ability to contribute			
Payment for Services	Unwilling	Poor	Fair	Good	Unable	Poor	Fair	Good
Management of Services	Unwilling	Poor	Fair	Good	Unable	Poor	Fair	Good

GUIDELINES FOR FILLING IN FORM

Note: A number of Comment Boxes are provided below certain of the tables. Please write in these any comments, or extra information relevant to the topic of the Table that you feel may help us to understand the conditions in your community.

B100: GENERAL DETAILS OF TOWN/ VILLAGE/ COMMUNITY

Table field	Explanatory notes
Community Number	This will be entered by the research staff
Organisation filling in this form	Enter the name of the organisation responsible for the completion of this form, e.g. Local development forum, Water Committee, etc.
Person filling in this form	Enter the name of the person filling in the form and telephone number, if available, where this person may be contacted for further information

B101: Location of Town/ Village/ Community

Table field	Explanatory notes
Name	Enter the official name of the Town/ Village/ Community (as it appears on maps)
Other names	Enter any other names by which this community is known
List of Local Government Bodies	Enter the names of all local government bodies that exist in the area, and the administrative area in which the community falls.

B102: Management of facilities

Table columns	Explanatory notes
None	Indicate with a tick (√) if any of the organisations listed in the first column do not exist in the area
Show no interest	For those organisations that do exist in the area, indicate with a tick (√) those that show no interest in the management of the water and sanitation facilities.
Lacking capability	For those organisations that manage facilities in the area but are lacking any capabilities, indicate with a (√) in one or more of the three columns, the reason for this lack of capabilities
Fully functional	If any of organisations are managing the facilities in the area efficiently, enter a tick (√) in this column.

B103: Types of systems

Table columns	Explanatory notes
Water	Enter the percentage of the population who receive water from regional and local schemes, or have their own individual supply. The three percentages in this column should add up to 100 %
Sanitation	

B201: Design standards of Existing Services

Table	Explanatory notes
RDP levels	See the Explanatory Table in the Questionnaire for the RDP Guidelines for water services. Count the number of 25 liter cans of water that can be drawn per day from water source, and compare this with the number of persons using that source to determine the RDP levels. The percentages in the five categories should add up to 100 %

B202: Existing Source, Quality and Usage

Table columns	Explanatory notes
	See the Tables of Codes for Source Type, Quality and Reason Source not Used, following below this Table, to be entered in the appropriate columns.
Name	Enter the community name for the water source
Type of source	Enter the Code for the type of source - see the different types below
Fit for human consumption	Enter a "Y" (Yes) or "N" (No) to indicate whether the water is fit for human consumption
Quality	Enter the Code for the quality of the water - see the different categories below
Used for other purposes	Indicate with a tick (√) in the appropriate column if the source is also used for other purposes. If it is used for a purpose other than irrigation and livestock, indicate the type of use in space of Comments below
Reason source not used	If the water of the source is not used, enter the Code why this source is not used - see different reasons below.
Other community using the source	Indicate with a tick (√) if the source is shared with other communities.

B203: Existing Infrastructure & Ability to Serve Community at Basic Minimum Standards

Table columns	Explanatory notes
Type	See the Codes for the different types of infrastructure below and enter the appropriate code in this column
Original design capacity	When the infrastructure was originally installed, how many 25 liter cans could be drawn from it per day. Compare this number with the number of persons using this infrastructure (pump, etc.) in 1995 and then enter the percentage which could be provided with 25 liters per person per day in the first column. Enter the percentage of the people using this infrastructure in 1995 who lived less than 200m from the source in the second column.

Existing capacity	See the RDP Guidelines in Table B201, and then enter the percentage of the present population using this water point which can be served at the RDP level.
Infrastructure not used or fully utilised	If the infrastructure no longer provides the same quantity of water as when originally installed, indicate the reason by entering a tick (√) in the appropriate column. If you enter a tick in the "Other reason" column, indicate the reason in the space for Comments below.
Other community using this source	Indicate with a tick (√) if this infrastructure is also used by other communities

B204: Connections

Table	Explanatory notes
House connections	If some of the houses in the community are served by a piped water system, enter the percentage of houses connected, and indicate with a tick (√) if the system needs repairs.
Meters	Enter the percentage of connections where the quantity of water is measured by meters, and indicate with a tick (√) if any repairs are needed.

B205: Existing Standards of Services to Residents

Table columns	Explanatory notes
Quantitative supply	Indicate the percentages of the 1995 population who had a water supply with a capacity of less than 10 liters, and between 10-25 liters per person per day.
Distance to supply	Indicate the percentages of the 1995 population who had to walk the following distances to the water supply, less than 200 meters, 200-500 meters, more than 500 meters.
Reliability	Indicate the percentages of 1995 population who had access to water for 98 % of the time during the year (i.e. not more than one week of unavailability).
Flow rate	Indicate the percentages of 1995 population who had access to water at a rate of at least 10 liters per minute (i.e. a 25 liter can will take 2 ½ minutes or less to fill).

B301: Existing Sanitation Types

Table columns	Explanatory notes
Treatment Works	See the Explanatory Table in the Questionnaire for the RDP Guidelines for Sanitation, and then enter the percentage of the population which falls in each category. The three percentages should add up to 100%

B302: Treatment Works

Table Columns	Explanation notes
Health Risk	Enter the percentages of the population where the sanitation systems used are no, some, or a serious health risk to the community. The three percentages should add up to three percent.
Environmental Risk	Enter the percentages of the population where the sanitation systems are no, some, or a serious risk to the environment (e.g. the smell may be offensive, or after rains it may wash into and contaminate rivers and other water sources, etc.). The three percentages should add up to three percent.
Functional deficiencies	Enter the percentages of the population where the sanitation systems used are functional deficient (i.e. not working properly). The three percentages should add up to three percent.

B400: Environmental and Other Constraints on Sanitation and Water

Table columns	Explanatory notes
Water supply	Tick ( ) the “Yes” opposite the appropriate type of constraint if this is causing a constraint on the provision of water. In the space after the “Yes” there is room for you to add any comment you think will help to describe the situation
Sanitation	Tick ( ) the “Yes” opposite the appropriate type of constraint if this is causing a constraint in the provision of sanitation. Only consider that part of the community lacking proper sanitation facilities. In the space after the opening “Yes” there is room for you to add any comment you think will help to describe the situation. Further reasons for sanitation constraints (various factors constraining the development of sanitation) are set out in more detail below.

Table field	Explanatory notes
Geology: Shallow rock	Mark this line as “Yes” if shallow rock is found underlying a part of the community, preventing the use of pit latrines or similar facilities.
Soil: Clay	Mark this line as “Yes” if a part of the community is situated on clay material, preventing the use of pit latrines or other similar onsite facilities.

Surface Water	Mark this line as "Yes" if .the community is situated close to permanent surface water (which forms part of the community's main water source), and which could possibly be contaminated by onsite sanitation facilities.
Geohydrology (underground water)	Mark this line as "Yes" if the water table is shallow, or if the underground water could be contaminated adversely by on-site sanitation facilities.
Flora	Mark this line as "Yes" if sensitive flora (plants, etc.,) is found close to the community and which may be endangered by the use of pit latrines or other similar facilities.
Close to river	Mark this line as "Yes" if community is situated close to a river (which forms the community's main water source), and which could possibly be contaminated by on site sanitation facilities.
No water	Mark this line as "Yes" if no water is available, preventing the use of waterborne sanitation.
Other	Mark this line as "Yes" if any other types of unacceptable conditions persist at the site which may affect the use of any particular sanitation facility.

B: 402 Management / Constitutional Constraints

Table	Explanatory notes
Management/ Constitutional Constraints	Please write any comments you have about any constraints due to factors involving management or institution (e.g. traditional customs, organisations, etc.), which you think will affect the provision of water and sanitation to the community

B403: Community Attitudes and Ability

Table	Explanatory notes
Attitude towards payment for services	Indicate with a tick (√) whether the people in this community are unwilling to pay or have a poor, fair, or good attitude to payment for services.
Potential ability to contribute to services	Indicate with a tick (√) whether the people in this community are unable to pay or have a poor, fair or good potential ability to pay for services
Attitude towards management of services	Indicate with a tick (√) whether people in this community are unwilling to manage or have a poor, fair or good attitude to managing their services
Potential ability to contribute to the management of services	Indicate with a tick (√) whether people in this community are unable to manage or have poor, fair or good potential ability to take on the management of their services