Sustainable Handpump Projects in Africa

Report on Fieldwork in South Africa

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Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
BoTT	Build, Operate, Train and Transfer
CBO	Community Based Organisation
CDO	Community Development Officer
CMIP	Consolidated Municipal Infrastructure Programme
DC	District Council
DFID	Department for International Development
DWAF	Department of Water Affairs and Forestry
ESA	External Support Agency
EU	European Union
HIV	Human Immunodeficiency Virus
HPM	Handpump Mechanic
HTN	Handpump Technology Network
IDP	Integrated Development Plan
IMF	International Monetary Fund
ISD	Institutional and Social Development
KaR	Knowledge and Research
KZN	Kwazulu-Natal
NGDB	National Groundwater Database
NGO	Non-Governmental Organisation
NORAD	Norwegian Agency for Development Co-operation
PDI	Previously Disadvantaged Individual
PID	Partners in Development

PSC	Project Steering Committee
PVC	Polyvinylchloride
RDP	Reconstruction and Development Programme
RWSS	Rural Water Supply and Sanitation
VLOM	Village Level Operation and Maintenance
UNCEF	United Nations Children's Fund
WEDC	Water, Engineering and Development Centre
WHO	World Health Organisation
WSA	Water Services Authority
WSP	Water Services Provider

1. Introduction

1.1 Research project

This report has been produced as part of the second phase of a KaR (Knowledge and Research) project (R7817) entitled *Guidelines for Sustainable Handpump projects in Africa*. This research is funded by the UK Department for International Development (DFID) and is being carried out by the Water, Engineering and Development Centre (WEDC) at Loughborough University, UK.

For many years, handpumps have been considered an appropriate water supply option for low-income communities, but in many cases, particularly in Africa, they have fallen into disuse shortly after installation. The project aims to collect data from successful handpump projects and synthesise them into a set of guidelines that can be used by planners, implementers and decision-makers to prepare future handpump projects that have an improved chance of long-term sustainability.

The stated purpose of the project is:
Improved benefits from communal handpumps in Africa through an increased application of factors affecting sustainability in new projects

For the purposes of the research a sustainable handpump project is defined as one in which *the water sources are not over-exploited but naturally replenished, facilities are maintained in a condition which ensures a reliable and adequate water supply, the benefits of the supply continue to be realised by all users over a prolonged period of time, and the project process demonstrates a cost-effective use of resources that can be replicated.*

Full details of the research project and the outputs produced so far can be accessed on the project web site at
http://www.wedc.ac.uk/projects/shp/index.htm
The outputs so far include:

- A literature review
- Draft guidelines for field evaluation of handpump projects
- A report on a half-day workshop on handpump sustainability
- A report on an electronic conference on handpump sustainability
- Report on fieldwork in Zambia
- Report on fieldwork in Ghana
- Report on fieldwork in Kenya
- Report on fieldwork in Uganda
- Interim report

This is the last of five reports on fieldwork carried out in different countries in Africa. Zambia was the first country to be visited for fieldwork during April and May 2002 where the 'Draft guidelines for field evaluation of handpump projects' were first trialed (Harvey and Skinner, 2002). Ghana was

visited during May and June 2002 where the main focus was on policy and institutional issues (Harvey et al., 2002); Kenya was visited during January and February 2003 where the primary focus was on socio-economic and technical aspects (Harvey et al., 2003); and Uganda was also visited in February 2003 to investigate institutional, operation and maintenance issues (Harvey, 2003).

1.2 The field visit

The field visit to South Africa took place in May and June 2003. The primary purpose of this visit was to learn from successful handpump projects by assessing which factors and structures contribute to project sustainability. The main objectives of the field visit were to:

- Investigate the effectiveness of different project approaches in contributing to sustainability of handpump-based water supplies in Kwazulu-Natal;
- Investigate different institutional and management set-ups for O&M and respective effectiveness /efficiencies;
- Assess levels of financing required for initial installation costs and recurrent O&M costs;
- Identify what factors affect the willingness to pay for O&M among end-users;
- Investigate primary differences between rural water projects using handpumps and those using alternative technologies with reference to sustainability.

The field trip was planned in collaboration with the Department of Water Affairs and Forestry (DWAF) and Partners in Development (PID).

1.3 Methodology

The visit to South Africa focused on Kwazulu-Natal province (Figure 1). A number of interviews were conducted with key stakeholders including project staff, local government personnel, handpump repairers and private companies. Several visits to communities were also undertaken and informal focus group discussions held.

A list of projects visited and persons met is provided in Appendix 1. A series of checklists was used to guide interviews and discussions with stakeholders, these are presented in Appendix 2.

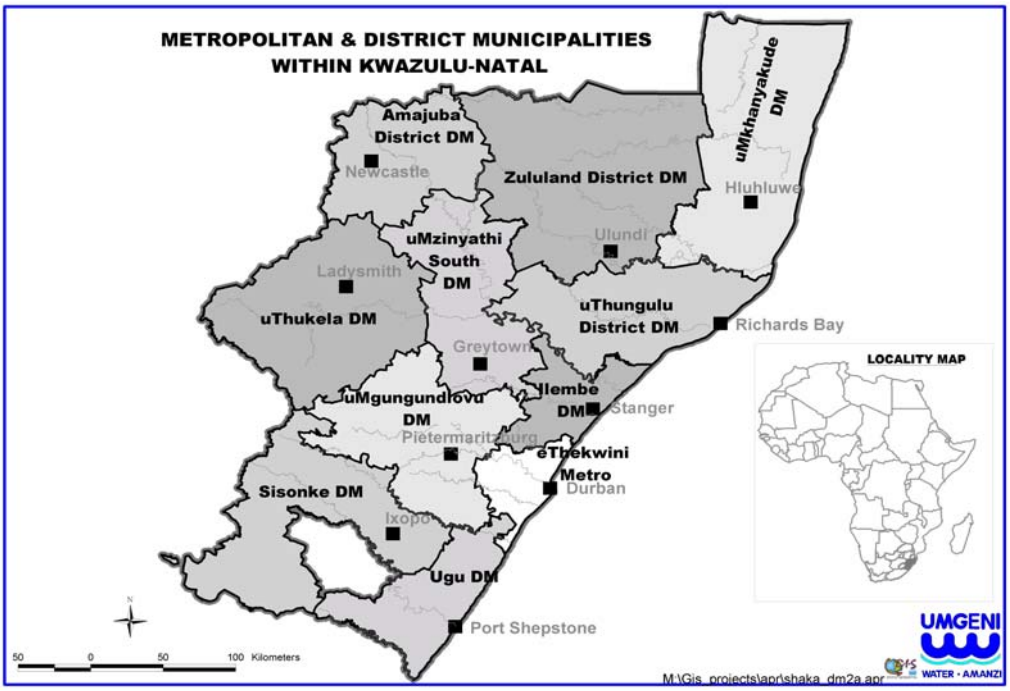

Figure 1: Map of Kwazulu-Natal Province

The opinions expressed within this report are solely those of the authors and are based predominantly on observations made and information collected during the visit.

2. Handpump provision and maintenance in South Africa

2.1 Policy context

2.1.1 Overview of rural water supply in South Africa

The Bill of Rights of the Constitution of South Africa (Section 27, 1b) states that 'everyone has the right to have access to sufficient water'. Approximately 23 million of South Africa's population of 43 million live in larger urban centres where they have access to a reliable supply of potable water, and a further 6 million live in smaller towns and rural centres served by systems built prior to 1994 (Still, 2001a). The challenge for ensuring access to sufficient water is therefore greatest by far in the rural areas of the country.

WHO/UNICEF estimates indicate that access to improved water sources stood at 72% in rural areas in 1994 and rose to 73% in 1995. The estimate for 2000 remained at a level of 73% (WHO/UNICEF, 2001). These estimates were based on the WHO/UNICEF Water Supply and Sanitation Sector Monitoring Report (1996), the South African National Census (1996) and October household surveys conducted in 1994 and 1995 (see Table 1).

Table 1: October Household Survey, RURAL areas

	1994	1995
Water supply facility		
Piped water (household or public standpipe)	51.7%	51.6%
Water carrier/tanker	1.8%	2.5%
Handpump-equipped borehole	***12.6%***	***10.9%***
Borehole with engine	4.7%	4.8%
Rainwater tank	1.6%	4.2%
Unprotected surface water	19.2%	18.7%
Open well	1.3%	1.2%
Protected spring	0.8%	1.4%
Unprotected spring	4.9%	4.1%
Other	1.3%	0.7%
Total	*100%*	*100%*

Source: WHO/UNICEF (2001)

The household survey for rural areas in October 1994 indicated that 12.6% of households relied on handpump-equipped boreholes for their primary water supply, while 51.7% relied on piped water (household or public standpipe). The repeated survey in October 1995 indicated that only 10.9% of households relied on handpumps with 51.6% dependent on piped water systems. The decrease in reliance on handpumps appears to be balanced by increases in the use of water tankers, rainwater tanks and protected springs, not in reticulated schemes. Unfortunately, no surveys with this level of detail have been conducted more recently, and hence it is not possible to determine exactly how the situation has changed since 1995.

According to the Department of Water Affairs and Forestry (DWAF) 14 million people in South Africa had no access to safe drinking water in 1994 but 9 million have gained access since (DWAF, 2003a). This best case scenario leaves only 5 million people without access, but does not address the operational status of existing supplies. Some broad estimates suggest that as many as 16 million people have no operating water supply with their source of water an average distance of 1 km away (The Water Page, 2003). Undoubtedly, access has increased since 1994 but monitoring data for ongoing operation and maintenance are lacking and the sustainability of many systems installed remains questionable.

2.1.2 Water policy

The Government's Reconstruction and Development Programme (RDP) was initiated in 1994 and is aimed at addressing the disparities created by racist legislation and practices in the past. The RDP sets a minimum standard of 25 litres of safe, clean water per person per day within 200 metres of homesteads for all South Africans. It is unlikely that all water supplies included in DWAF coverage figures meet the RDP standard.

The Government's White Paper on Water Policy, 1997 aims to set out policy for the management of both quality and quantity of water resources. This also led to the establishment of a Water Law and Water Services Act. The slogan of DWAF is described as 'Some, for all, for ever' which sums up the Government goals of:

- access to a limited resource (some)
- on an equitable basis (for all)
- in a sustainable manner, now and in the future (for ever).

The Water Services Act, 1997 defines the role of the Water Services Authority (WSA) – the municipality – and the Water Services Provider (WSP) – the entity appointed by the municipality to supply the services (this function can be conducted by the municipality itself, the private sector or community-based organisations).

2.1.3 Free basic water

The Government's free basic water policy was first announced by President Mbeki in September 2000 and was approved by Cabinet in February 2001, for implementation in July 2001. The Government White Paper states that 'only that water required to meet basic human needs and maintain environmental sustainability will be guaranteed as a right.' The free basic water policy is presented by DWAF as a realisation that there are many South Africans that cannot afford to pay for services essential for health and basic human needs, which they should receive by right. Thus the policy stipulates that households are entitled to 6000 litres of clean water every month at no cost. It, however, also maintains the principle that those who use more than the stipulated volume of free water must be responsible for the costs. Free basic water is to be funded using a combination of the equitable share of revenue of local government and internal cross-subsidies from appropriately structured water tariffs specific to the respective local government area.

The intended consequences of the free basic water policy are to ensure that:

- more people are served with water (no-one is excluded due to poverty);
- more water is used by those served (people are not deterred from using more water due to high cost); and as a result
- public health is improved.

According to DWAF (2003b), already more than 27 million people in the country are benefiting from the policy. This equates to approximately 60% of the country's population receiving an amount of free basic water each month. However, not all local authorities have been able to implement the policy, primarily due to financial constraints. The Government of the African National Congress (ANC) has been accused of using the policy as a 'vote winner' rather than an achievable goal. Large cities such as Durban can afford to cross-subsidise in order to provide free basic water to its most marginalised people, but this becomes much harder for smaller settlements and rural areas. Since most people in rural areas use less than 6000 litres per month there is negligible revenue from water tariffs and a need for complete subsidisation by under-resourced local Governments.

Critics of the free basic water policy argue that the availability of capital funds and ability of the sector to spend are insufficient in order to deliver RDP service levels to all, to begin with; and that the ongoing recurrent operation and maintenance (O&M) costs cannot be met by many Local Governments. Still (2001b) argues that the free basic water policy is also likely to lead to some unintended consequences such as disempowerment of community structures, devaluation of water and associated assets, and cost escalation of capital and maintenance costs.

2.2 Institutional issues

Traditionally local Government municipalities have played the role of WSA and WSP. This is still the case in some areas but is gradually changing. It is now more common for the private sector to take on the role of WSP while the municipality acts as regulator only.

2.2.1 Government structure

Government consists of several different levels; namely National, Provincial, Metropolitan (larger urban areas), District and Local municipalities or councils. At National level the Department of Water Affairs and Forestry (DWAF) is primarily responsible for the formulation and implementation of policy governing water resources, water supply and forestry resources. It also has overall responsibility for water services provided by local Government. Recent Government reforms, since the Local Government White Paper of 1998, have led to a gradual decline in the powers of Provincial Governments since the number of local authorities has been substantially reduced and these have been granted more active roles in socio-economic delivery.

Unlike many other African countries the Local Municipality is the smallest unit while the District is the next level up. There are 47 District Councils (DCs) in South Africa and 10 of these are situated in Kwazulu-Natal (KZN). There are 50 Local Councils (LCs) in total in KZN giving an average number of LCs within each District of 5, although this varies considerably. From 1 July 2003 responsibility for water supply was shifted from the Local to the District Municipalities. This step of 're-centralisation' has arisen due to a number of factors but a key factor appears to be the political drive to provide large-scale piped 'bulk' water systems which can be better managed at District rather than Local level. According to the Municipal Structures Act of 1998, District Councils must seek to achieve the integrated, sustainable and equitable social and economic development of its area by promoting bulk infrastructural development and services for the district as a whole.

Insufficient Government capacity at District and Local Council levels is perceived by many to be a major constraint to successfully implementing Government policy. Many local authorities lack the appropriate personnel (especially technical staff) and bureaucratic structures, or lack the resources to support development or to ensure a level of service provision that meets national standards. According to the constitution, developing the capacity to deliver services according to the stipulated criteria must also be undertaken in a fiscally sustainable manner based upon affordability rather than a basic needs assessment. This fiscal constraint is highly daunting for many municipalities, especially those which are predominantly rural.

2.2.2 The private sector

There is a vibrant and well-established private sector in South Africa, and in contrast to local Government, the capacity of the private sector, especially in

technical areas, is very strong. Private companies and consultants provide expertise in hydrogeological surveying, drilling, handpump installation, maintenance and repair. There are also several handpump manufacturers based in the country which provide warranties and after sales service.

Delivery of rural water supplies and services relies heavily on private consultants. Local Government authorities contract out consultants to design and implement rural water supply systems including spring protection, piped systems and handpump-equipped boreholes. The decisions relating to technical aspects, such as model of handpump and depth of installation, are generally taken by the consultant with little regulation from Government.

Since the vast majority of South Africa's educated professionals and private consultants are white, the current Government has established affirmative action policies to encourage the development of private entities with majority black or Asian ownership. Previously Disadvantaged Individuals (PDI) or non-white contractors are referred to as 'emerging' and receive specific incentives and dispensations from local Government. Currently, many emerging contractors have limited capacity and undertake contracts for borehole rehabilitation and repairs rather than implementation of new supplies. This may change over time as they develop greater capacity through the affirmative action programme. However, due to the irregular nature of many maintenance contracts some emerging contractors may go out of business if demand for their services is not consistent and sustained.

2.2.3 External support agencies

South Africa is less dependent on external support than many other African countries but still receives significant external funding for water supply, in particular from the European Union (EU). Other donors include USAID, AUSAID and DFID but funding is normally directed at discrete projects rather than extensive sector wide approaches.

The World Bank and International Monetary Fund (IMF) have historically influenced the development of National policies in South Africa including the imposition of user fees for the provision of basic services, such as water, and the use of the private sector in service delivery. However, unlike many other African countries, the limited financial 'assistance' provided by these institutions and the lack of trust created by IMF support for the apartheid Government has meant that the current Government has been able to set its own priorities and develop policies independently. An example of this is the free basic water policy which goes against the private sector market-driven approach promoted and expounded by the World Bank and IMF.

There are relatively few international or local Non-Governmental Organisations (NGOs) involved in water supply in South Africa. However, some rural water supply consultants market themselves in a similar way to NGOs and in addition to undertaking contracts for Government seek external

funding for community water supplies. Partners in Development (PID) is a good example of this and carries out projects funded directly by external donors such AUSAID, Norwegian Agency for Development Co-operation (NORAD) and the EU. One advantage of this dual approach is that they are able to cross-subsidise development priorities to some extent.

2.2.4 Community based organisations

Some NGOs such as Mvula Trust and consultants such as PID and VBA Groundwater have promoted the concept of Village Level Operation and Maintenance (VLOM) and community management of water supplies. This involves the promotion of community-based organisations (CBOs) to operate, maintain and manage their own water systems. These efforts had some success although this was limited by the widespread perception that Government should provide services free of charge and a lack of consistency in implementation. The free basic water policy has now compounded these constraints and many implementers have abandoned attempts to work with CBOs.

In theory, a CBO can be appointed by the municipality to be a water service provider in place of a private company or the municipality itself. However, this requires significant skills, resources and organisation within the community which are rarely present unless previous empowerment and capacity building activities have been undertaken.

2.3 Funding

2.3.1 Capital costs

The average cost of a handpump-equipped borehole in South Africa ranges between R35-45,000 (US$4,500-5,800) including borehole drilling and development (typical depth 80m), the handpump and installation. Based on an average of 300 people per handpump this equates to an average per capita cost of R130 (US$17). Whilst this cost is considerable it is significantly lower than comparable costs for piped bulk water systems which average R3,500 per household or R700 (US$90) per person .

2.3.2 O&M costs

Data on operation and maintenance (O&M) costs are much harder to find than capital costs. Table 2 presents a rough estimate of monthly and unit costs for handpump water relative to water from pumped water schemes. As can be seen, even based on relatively inefficient public-private maintenance schemes (see 2.7.2) O&M costs for handpumps are significantly lower than those for pumped reticulated schemes.

Table 2: O&M costs		
	Typical cost per kilolitre	Typical monthly cost per household
Handpumps, wells, gravity schemes	R2.50 - 10	R11 - 18
Pumped reticulated schemes	R5 - 47	R33 - 70

Source: Still (2001b)

2.3.3 Government and donor funding

DWAF reported that it had spent R4.22 billion (US$550 million) on new water supply projects between 1994 and March 2001 (DWAF, 2001). In recent years spending has gradually increased and during the 2002/03 financial year R1.46 billion (US$190 million) was spent by the DWAF on the rural basic water supply capital programme. However, this not only included water projects but also sanitation projects, water sector and institutional support programmes. The physical infrastructure component of this programme in the same year amounted to an expenditure of R814 million spread over 497 water projects countrywide. In 2003/04 DWAF will be financing 546 water projects countrywide, of which some 18% are new projects, to an amount of R845 million. This amounts to a 4% increase in expenditure (DWAF, 2003c).

The majority of this funding is provided by central Government which has increased allocations of funding from the National Fiscus via the equitable share to fund free basic services. Approximately 25-30% of the rural water supply budget is funded by the EU. In addition to the DWAF programmes there are other major capital programmes managed by other Government departments such as the Consolidated Municipal Infrastructure Programme (CMIP) managed by the Department of Provincial and Local Government (DPLG). The overall Government funding for rural water supply projects currently amounts to about R1 billion (US$130 million) per year.

Critics argue that the average cost of delivering RDP service levels to those currently unserved is approximately R1500 per person (Still, 2001b); using the Government's own unserved population figures this equates to a cost of R7.5 billion. This refers to new water supplies only and does not include ongoing O&M costs. If the Government was to maintain spending at R1 billion per year for the next seven years and was to use this solely for funding new water projects it might meet the target of providing access to water for all by the year 2010. However, it is highly doubtful that all those who had gained access since 1994 would still have access by then due to inadequate finances and measures in place to ensure the sustainability of existing systems.

Despite the free basic water policy and the quoted volume of 6000 litres per household per month, there appears to be some inconsistency in how this is interpreted and implemented. District Municipalities are free to decide how

many litres of water should be provided free of charge and can set appropriate tariffs for additional quantities.

Similarly, budgets for O&M support are determined at District level and vary considerably. Table 3 below presents the budgets for O&M of the then seven District Councils in KZN in October 2000. Two of the seven municipalities had no fixed budget for O&M and funding was provided on an ad-hoc basis only. Whilst the remaining five did have fixed budgets these varied considerably, as did the number of handpumps repaired or maintained, and the average cost per installation repaired. The term 'repair' can be somewhat misleading since this often means replacing the entire pump and piping rather than simply repairing the faulty part; this may depend on the severity of the problem but can also be due to the conditions of the repair contract.

Table 3: Handpump O&M costs in Kwazulu-Natal by District Council (DC)

	DC29	DC27/ 28	DC26	DC24/ 25	DC23	DC22/ 43	DC21
Annual budget for handpump maintenance / operational support	R0.8 million	R2 million	Ad Hoc	R2.3 million	R0.3 million	R0.1 million	Ad Hoc
Average cost per installation repaired (* one-off with training)	R2300	R1800	N/A	R7500*	R7500*	R5100	R3000
No. of handpumps repaired/maintained in 3 years preceding October 2000	406	1800	N/A	750	300	>30	>100

Source: van Niekerk and Still (2002)

2.3.4 Community financing

Up until the free basic water announcement in September 2001 the official line of the Government was that users were supposed to pay for handpump maintenance. In practice, however, this rarely took place due to a lack of political will. Rural areas of South Africa were formerly part of 'homeland' administrations which were part of the apartheid system, and services were generally installed free of charge to try to win the favour of people. As a result there has been a strong culture of non-payment among communities and an expectation that Government should provide services at no cost to the community.

Little attention was given to community involvement and sustainability issues although some consultants such as PID and VBA Groundwater did attempt community-based VLOM approaches and in some cases users would collect money to pay a local contractor or mechanic directly. Now with the free basic water policy in place these cases are even less common and the full costs of handpump maintenance and repair will be borne solely by local Government

for the foreseeable future.

Some attempts were made to assess willingness to pay among users and despite an often stated willingness the perception that Government should provide remains strong. A few exceptions were found where communities tired of waiting had bypassed local Government channels and contacted and paid contractors directly. These cases were, however, few and far between.

2.4 Project implementation

2.4.1 Past approaches

State involvement in handpump-based rural water supplies in Kwazulu-Natal began in the 1960's and accelerated in the 1980's when the Kwazulu Department of Agriculture and Forestry became responsible for rural water supply and provided between 400 and 800 boreholes per annum. Since then a number of emergency and relief programmes have been implemented resulting in a large number of handpump-equipped boreholes. The approach taken was very much supply-led and priorities were determined by centralised Government authorities. Between 1994 and 1996 responsibility for rural water supply in KZN was transferred to seven new Regional Councils, each responsible for developing their own policies and practices. In December 2000 the seven Regional Councils transformed into ten District Municipalities.

Although the Government never officially adopted VLOM as the standard approach to handpump water supply, some NGOs and contracted-out consultants implemented the VLOM approach, particularly in the mid and late 1990's. Communities were expected to make an 8% initial contribution to capital costs and finance all ongoing O&M costs. Such initiatives had limited success, primarily due to lack of support and follow-up to ensure sustained community financing and continued user perceptions that water supplies belong to the Government which should therefore support O&M. Such perceptions were only reinforced by DWAF which undermined attempts at VLOM by continuing to wholly finance installation and repairs. Community water committees were made up of volunteers who were often subjected to intimidation by users and many soon became reluctant to undertake these roles. The introduction of the free basic water policy in 2001 effectively put the nail in the coffin for community management and financing of handpump water supplies.

2.4.2 Current approaches

District Municipalities, as Water Service Authorities, have become the primary driving forces in the delivery of rural water supplies, and each council has developed its own policies and philosophies regarding handpump water supplies, which vary considerably. Some councils recognise the

importance of the handpump as an appropriate rural water supply technology and have developed appropriate institutional and financial frameworks to support delivery and O&M. Other councils have largely ignored handpump water supplies and operate on an ad-hoc basis, particularly regarding maintenance, repair and rehabilitation.

In 1997 DWAF introduced the Build, Operate, Train and Transfer (BoTT) programme. BoTT is a public-private partnership whereby funding is from the public sector (delivered through DCs) and private partners undertake project implementation. BoTT is primarily targeted at poor communities and small, poorer towns. One of the key principles is that sustainability can only be achieved by actively involving communities and local government in all stages of the project life cycle. BoTT thus attempts to build up capacity within institutions, communities and councils in order to pursue an integrated and participatory project development approach. A 'one-stop shop' capacity is created via a consortium of service providers with expertise in five key disciplines: design, construction, O&M, on-site sanitation, and Institutional and Social Development (ISD).

BoTT has come under considerable criticism from NGOs, sector professionals and independent researchers. One of the key issues is that despite the principle that communities should be involved in all stages of the cycle, this involvement is often tokenistic, involving little more than basic liaison in siting the borehole, and most new water supplies are still delivered through a supply-led approach creating little sense of ownership among users. The very term 'Build, Operate, Train and Transfer' implies that only once the water supply is operating successfully is appropriate training conducted and the supply transferred to the users. This contrasts to the VLOM approach which promotes community ownership and responsibility from project onset. BoTT is, fundamentally, the chosen mechanism to achieve the goals set in the RDP as rapidly as possible; issues of sustainability appear to be of secondary importance.

External funded water supply projects differ from Government initiatives in that there is greater freedom among implementers to determine both technology and management structures. Some NGOs and consultants argue that simpler technologies (e.g. Bucket pump or Rope and Washer pump), which are wholly owned, operated and maintained by communities and households at minimal cost, provide the most sustainable rural water supply option since they bypass bureaucratic and time-consuming Government procedures. Where external donors fund project implementation directly such approaches can be taken.

Figure 2: Bucket pump

2.5 Technical issues

2.5.1 Groundwater issues

The hydrogeology of Kwazulu-Natal is highly variable ranging from basement granites to cretaceous sediments through all the sedimentary phases. Groundwater is accessible within the primary sand aquifer along the coast, faults within sandstones, dolerite intrusions in shales and fractured and weathered basement complexes. Static water levels vary greatly but are most commonly found between 20m and 100m. In terms of water quality, excessively low or high pH is not generally a problem, although Fluoride, Iron and Manganese occur in high concentrations in some areas. Saline water is a considerable problem both in some coastal areas and in geological zones dominated by tillites.

The complex hydrogeology makes borehole siting a considerable challenge in some areas, which is further complicated by the location and scattered nature of many rural settlements. Borehole siting methods vary depending on the hydrogeological zone. Some consultants use Very Low Frequency (VLF) Electromagnetic (EM) methods and magnetic surveys while others adopt time-domain EM and resistivity imaging.

There is a wealth of groundwater data in South Africa, especially when compared to other African countries but no single accurate and comprehensive database. A survey of Kwazulu-Natal District Municipalities in 2000 indicated that 6 out of 7 then Councils had developed in-house borehole databases linked to GIS systems (van Niekerk and Still, 2000). However, the data were incomplete or duplicated in most of these databases. The DWAF National Groundwater Database (NGDB) and DWAF Regional Office (provincial) database are also currently outdated and incomplete. Groundwater consultants such as Aquamanzi have accurate and comprehensive databases but only for limited geographical areas. There is a reluctance among NGDB managers, groundwater consultants and implementing agents to share and exchange information leading to considerable duplication in some areas and gaps in others.

2.5.2 Technology choice

In general, South Africa has higher expectations regarding service levels than in the rest of sub-Saharan Africa. This factor, coupled with the historical and political perspectives regarding disparities in service levels between different racial groups, means that for many people piped water supply is considered the only appropriate technology option. The preamble to the Government's White Paper on Water Policy quotes the South African poet and broadcaster Antje Krog and ends with the following paragraph:

'Water – gathered and stored since the beginning of time in layers of granite and rock, in the embrace of dams, the ribbons of rivers – will one day, unheralded, modestly, easily, simply flow out to every South African who turns a tap. That is my dream.'

Whilst this may be a worthy goal the fact that a key strategic Government document predetermines technology (i.e. piped water supply) presents a significant challenge to the sector. Handpumps and cheaper alternatives are seen by many at political levels as sub-standard and this attitude inevitably permeates into other sectors of society. Many District Integrated Development Plans (IDPs) concentrate on piped surface water schemes and do not consider groundwater or handpumps at all. If piped water supply is the only technology recognised as appropriate by Government the necessary support structures for handpump water supplies will not be put in place and the low reliability of handpumps will increase negative perceptions among users. Some Government personnel, especially at local level, and many sector professionals recognise the importance of the handpump as the most appropriate technology in many cases, but unless there is political recognition of this, the sustainability of existing community water supplies will be threatened.

The scattered nature of many rural communities in KZN means that reticulated water supply is a major infrastructural challenge, which simply compounds the considerable financial constraints. A proposal for a piped water system recently submitted by Msinga Local Council to the District

Municipality was rejected because the cost per household was R7,000 which is double the Government limit of R3,500. However, due to the difficult topography and distribution of homesteads it is unlikely that a piped system could be implemented any cheaper in this case. This, therefore, suggests that on the basis of capital costs alone piped water supply is often an inappropriate technology.

When the operational costs are considered, the argument against piped water for rural communities becomes even stronger. During this short field visit a significant number of reticulated schemes were observed which had been installed within the past five years but were not operational. The predominant reason for this was that communities had not paid the electricity bills and therefore electrical supplies were cut off. In several cases communities had returned to using nearby handpumps while standposts remained without water. The handpump is considered to provide free basic water but water from the piped system must be paid for. However, where handpumps are not maintained and there is no priority given to this, communities have no choice but to go back to often unsafe and distant surface water supplies.

Figure 3: Handpump beside water tank for tankered water

The October household surveys of 1994 and 1995 indicated an increase in water supplies from water tankers, the use of which was also observed in the field. Many Local Municipalities in rural areas used to be able to access funding for several hundred handpump-equipped boreholes per year but are now unable to provide many new supplies since District Municipalities proclaim long-term plans for bulk water systems. As a result, some Local councils seek emergency measures to provide water to rural communities in the interim, which generally means providing plastic storage tanks and tankering water (Figure 3). This has normally been implemented in response

to crisis situations, such as cholera outbreaks, but in some cases has become an ongoing solution. Apart from being highly inefficient financially this has led to problems of handpumps being vandalised in some instances to ensure ongoing delivery of water by tanker.

Once again, the handpump is promoted as and perceived to be an inappropriate, inferior technology choice.

2.5.3 Handpump models and standardisation

It is estimated that there are 10,000 handpumps installed in the rural areas of Kwazulu-Natal (van Niekerk and Still, 2000). However, due to the large number of different databases and potential for duplication (described above) it is not clear how accurate this number is. Existing records indicate that over 80% of handpumps in KZN are MONO T5 and T7 pumps (Figure 4), making the Mono the closest to a standardised pump in South Africa. However the following models can all be found in the province:

- Mono;
- Orbit;
- Cemo;
- Climax;
- Afridev;
- Vergnet;
- Pulsar;
- Barry;
- Bushpump;
- Bucket pump;
- Play pump; and
- Rope and washer pump.

Figure 4: The Mono T7 pump

The Mono pumps are helical rotor positive displacement pumps which can operate at heads above 100m, as are the Orbit and Cemo. Mono are robust and durable pumps, with an established history of manufacturing in South Africa. However, like most handpumps, designs have remained unchanged

over many years and the emphasis seems to be placed on lowering cost rather than improving quality. This is a direct result of the demands of customers who put price before quality, rather than limited capacity among manufacturers. These helical rotor pumps are not VLOM pumps since they are not easy to maintain at community level and require heavy lifting gear to bring the down-the-hole components to the surface.

The Afridev and Bushpump are reciprocating lever pumps, whilst the Vergnet and Barry are displacement pumps. All four can be classed as VLOM pumps since they are relatively simple to maintain and repair, and this can in theory be undertaken at community level. In general, all four models operate best at lower heads and are relatively small in number in the province. The Bucket pump and Rope and Washer pump are not traditional handpumps but definitely can be classed as VLOM and are included for the purposes of this study (see 2.5.6 below).

The Play pump (Figure 5) is a relatively new invention which operates by spinning a roundabout to pump water from a borehole to an elevated tank, which feeds a tapstand. The principle behind this is that while children play on the roundabout they pump water. The cost of maintenance and repair is met by the advertising fee paid by the sponsor to display their advertisement on the elevated tank. This approach appears to work best a) at schools and b) beside roads where the advertisements will be seen by many. Where these two criteria are not met it becomes a cumbersome and ungainly pumping method which is largely inappropriate for community water supplies.

Figure 5: The Play pump

There is no National or Regional policy on handpump standardisation and if any such policy were to be put in place this would inevitably occur at District level. Awareness of different handpump models is fairly limited due to the predominance of Mono, and the benefits of VLOM pumps such as the Afridev and Vergnet may not be immediately clear where Government managed systems predominate. Formal standardisation policies may not be necessary but there is undoubtedly a need for municipalities to be aware of the different options available and the consequences of choosing these. The research team visited Nokweja where there were a total of 27 handpumps but 7 different models, installed by different implementing consultants. At the time of the visit 30% of pumps were non-operational even though there was an active handpump mechanic in the area. The main reason for this was because he was only trained and equipped to repair two of the existing models.

Recently a South African Chapter of the International Handpump Technology Network (HTN) was formed to provide a forum for ongoing debate on handpump technology choice and associated topics. This is a welcome initiative which highlights the recognition, by some sector professionals, of the importance of the handpump as an appropriate water supply technology in South Africa. However, the question of 'which handpump?' is perhaps far less important in the South African context than 'piped water or handpump?'.

2.5.4 Technical problems with pumps

There are particular technical problems associated with each of the pumps in KZN and many of these problems have been widespread for prolonged periods of time. This is primarily because there have been no incentives for manufacturers to improve their products, since their customers (DWAF, municipalities etc.) select equipment primarily on the basis of cost not quality or durability.

The rotary elements of Mono pumps are designed to withstand 1400 revs/min, whereas the maximum load measured when operated by hand is only about 87 revs/min. This means that there are almost never any problems with the pumping element. The most common problems experienced with the Mono pumps are the failure of the anti-reverse mechanisms, worn bearings and worn gears.

The Afridev is manufactured in South Africa but is not widespread in the country. Some consultants and NGOs have promoted its use and trained communities or pump mechanics to maintain and repair it. The most common problems with the pumps are reported to be worn rubber seals. Interestingly, one handpump mechanic visited, who was trained to maintain Barry and Vergnet pumps, was unable to repair nearby Afridevs, first and foremost because he did not have the necessary spanner to open the inspection cover!

The Barry pump is a South African manufactured VLOM foot pump working

on a similar principle to the Vergnet displacement pump but using unique components. A number of these pumps have been installed in Kwazulu-Natal and although maintenance is very easy they have experienced some problems. The main problem encountered is the loss of prime due to leaking past the O-rings. There is therefore a need to make the pump self-priming and minimise leakage. Barry pumps have also experienced wear on the submersible unit due to rubbing against the side of borehole (Figure 6). Due to these problems several Barry pumps installed by PID have recently been replaced with Vergnet pumps. However, the concept behind the pump is excellent and with appropriate funding for research and development the Barry pump could provide a real home-grown VLOM alternative. The Vergnet pumps are generally quite reliable and relatively easy to repair but are expensive and require imported spares.

Figure 6: Barry pump cylinder

2.5.5 Local manufacturing

In contrast to most African countries, the vast majority of handpumps found in South Africa are manufactured within the country. This certainly has a positive effect on the availability of replacement pumps and spare parts; it also creates competition in order to produce the best pump at the lowest price. The introduction of public domain pumps throughout South Africa is totally unnecessary but the local manufacture of pumps that can be repaired easily without the need for specialist equipment will reduce the financial burden on local Government. For deeper groundwater levels (deeper than 40m) the helical rotor pumps available have proven their appropriateness and it is unlikely that any more optimum solution will be developed, although designs

could be incrementally improved. However, such pumps are not necessary for shallower groundwater where cheaper VLOM pumps may be more effective and efficient.

2.5.6 Spare parts supply

Spare parts supply for pumps is not as great a problem as in many other African countries due to a higher level of industrialisation and well established local pump manufacturers. As a result, the concept of a spare parts supply network or supply chain is pretty much an alien one. Since spares are purchased predominantly by contractors, rather than communities or individuals, accessibility to larger industrialised areas is not generally a problem. The commercial viability of spares supply is a largely irrelevant question since pumps and spares are stocked and sold side-by-side. For example, Mono, Orbit and Climax pumps and spares are available in many of the larger towns of the province and are easily accessible to contractors.

Spare parts for the Afridev present slightly more of a problem, primarily due to the low density of pumps. There are only a small number of companies, such as Aquatec Pumps in Pietermaritzburg, that stock Afridev pumps and spares but turnover is relatively low (approximately 150 pumps per year), and profitability is limited by some NGOs importing pumps directly from India for their own projects. BRD Engineering and Contracting manufactures the Afridev in South Africa and can be easily contacted by telephone to supply spare parts to anywhere in the country.

Pumps such as the Vergent which rely on imported spares present the greatest obstacle to sustainable spare parts supply. In general, NGOs and consultants installing the Vergnet have to take steps themselves to ensure that spare parts are available for these pumps. This normally means importing additional spares from France when purchasing the pumps and is likely to continue only as long as more Vergnet pumps are installed in future.

2.5.7 Simpler technologies

Experience from all over Africa indicates that, where given a choice, users tend to opt for water supply technologies that have proven reliability and which they are able to afford, especially where it is clear that they will be responsible for ongoing O&M costs. In some cases this will be piped water supply, in others it will be the handpump. Communities have been known to approach consultants and specifically request handpumps as their chosen technology, and despite the fact that the handpump is considered a sub-standard technology by many, in some parts of South Africa people opt for even simpler technologies.

The Bucket pump is a prime example of simpler technology. Originally developed in Zimbabwe, the Bucket pump is operated by a rope and windlass in a simple PVC-lined tubewell. The ‘bucket’ consists of a galvanised steel cylinder with a simple valve in the base which allows the cylinder to fill when

it is lowered into the water and which closes when the bucket is lifted to the surface. The bucket holds five litres of water and must be lowered and raised three times to fill the average household bucket or jerrican. This technology is so simple that it can be manufactured in any small town and it can be easily repaired at community or household level without any specialised equipment.

The PID Ubombo Family Wells Project in Maputaland in northern KZN consists of tubewells hand augured about 4.5m below the water table using a 'Vonder' rig. Most tubewells are constructed at homesteads, the total cost being R5,000, with a family contribution of R600 required. In some cases, tubewells are shared by families and in others entire communities use them (Figure 7).

Figure 7: Emehakatini community Bucket pump

In the coastal plains area such technology can be used due to relatively high static water levels, it is not appropriate for deeper groundwater areas. The project has developed a high level of acceptance of the Bucket pump despite the slow delivery rate for water (it typically takes 5 minutes to fill a 25 litre container). This is because the users understand the technology, recognise the high level of reliability and have a high sense of ownership and responsibility. In Mbaso tribal area one Pulsar handpump was vandalised within a week of installation since the community wanted a Bucket pump instead. Another community nearby declined the offer of a Pulsar pump to replace their Bucket pump, because they were more confident and comfortable with their existing 'low tech' supply. The Bucket pump certainly has limitations but its value has been clearly recognised by many communities.

Unfortunately, the acceptance of the Bucket pump at household and community level has not transferred successfully to political levels. RDP

funds allocated to one ward where tubewells were being constructed were designated for a piped water supply scheme in 1999. As a result, the Project Steering Committee (PSC) insisted that PID stop its subsidised tubewell programme in the area, and only operate where communities will not receive piped water. Four years later the water is still not yet flowing in the piped system and yet no more tubewells have been constructed in the area. One councillor on the PSC requested and paid for her own Bucket pump and tubewell because the piped water supply was 'not reliable', and later upgraded this by installing a submersible pump and water tank (Figure 8). The same PSC, however, has effectively blocked poorer households from obtaining similar, but subsidised, facilities. The budget for the piped system is sufficient to provide two tubewells for every household in the area and still have funds leftover. However, once again, technology choice is driven by status and sentiment rather than efficiency and effectiveness.

Figure 8: Upgraded Bucket pump

A step up from the Bucket pump but simpler than the handpump is the Rope and Washer pump which has the same advantage of being easy to maintain and repair by the users. PID have recently installed their first Rope and Washer pump on a tubewell in the Umbombo area (Figure 9) and are keen to expand the use of the technology. Experience from elsewhere within and outside Africa demonstrates its success as a sustainable rural water supply technology, especially at household level.

Figure 9: Newly installed rope and washer pump
Photograph: Stephen Nash, PID (2003)

2.6 Community and social issues

The nature of the rural communities visited in KZN is very different from that of most rural communities in other African countries. Settlements are generally scattered with considerable distances between households and there is often no clear centre or focal point for the community. Almost no subsistence farming was observed and most households rely on one or two family members who work in the cities or mines to send back money to the family each month. There are generally very few employment opportunities with perhaps only a school and clinic in each community. The high incidence of HIV/AIDS and bleak forecast concerning the disease have a huge impact on many communities throughout the province.

2.6.1 Ownership and responsibility

The sense of ownership and responsibility among users of handpumps is, in general, very low. The perception that equipment belongs to the Government and that it is wholly responsible for sustained service provision is widespread. The VLOM approach previously adopted by some implementers has led to a certain degree of hybridisation where communities attained a reasonable sense of ownership but are now aware of the free basic water policy and quite reasonably expect the Government to fulfil its promise. The one observed obvious exception to this is the Ubombo Family Wells programme where communities and households expressed and demonstrated a strong sense of ownership and took responsibility for operation and maintenance of Bucket

pumps, in part due to the simplicity and low cost of repair, and also as a result of the community-based approach adopted by the implementing agent.

2.6.2 Vandalism

Vandalism of handpumps appears to be much more common in South Africa than other African countries. The widespread perception created by proponents of reticulated water systems that borehole water is inferior to treated water has inevitably contributed to vandalism. Where communities have been promised piped water supplies, or even anticipate that they might get them, they are often reluctant to accept a handpump, even as an interim measure, since they believe this may jeopardise their chances of receiving piped water.

There may also be more subtle reasons for vandalism such as political/tribal differences; envy between communities without and communities with handpumps; disagreement over the siting of the handpump; the preference for simpler technologies (e.g. Bucket pump); loss of livelihoods for water vendors; and the use of pump components for other purposes. An example of the last case is the use of the Mono delivery pipe as a locally-made shotgun barrel in some areas; consequently a design change was introduced. Reports from one village with an existing handpump described how some young men from the community vandalised a newly installed handpump in the neighbouring community because the girls living there had stopped coming to their pump, impacting on their social life!

2.6.3 Community management

Since the end of white rule in 1994 rural communities have been empowered to make decisions democratically regarding their lives, but in reality it is often the traditional chiefs or war lords that have the final say. With the free basic water policy in place, local Government has overall responsibility for management of water supplies, but communities are expected to take responsibility for adequate drainage from the pump apron and keeping the pump surrounds clean. This rarely happens unless a dynamic opinion leader recognises the need.

2.6.4 Financial issues

The ability of communities to finance handpump maintenance is largely unknown although there are indicators, based on recurrent costs and income, to suggest that the basic ability exists in most communities. The willingness to pay, however, is very low, primarily due to the perception that maintenance and repair are the responsibility of the Government. This attitude has only been exacerbated by the free water policy of 2001.

2.7 Operation and maintenance

2.7.1 Handpump functionality status

The operational status of handpumps varies considerably throughout Kwazulu-Natal and rest of the country. Recent studies in South Africa indicate that at any one time typically 50% of handpumps in the field are not working or are working poorly, and that the time taken to repair broken pumps ranges from months to years (Hazelton, 2000). A survey of the operational status of handpumps by District Council was conducted in October 2000 and the reported proportion of handpumps operational at that time ranged from 40% to 90% (results are summarised in Table 4).

Table 4: Operational status of handpumps in Kwazulu-Natal by District Council (DC)

	DC29	DC27/28	DC26	DC24/25	DC23	DC22/43	DC21
Total no. of boreholes	685	4500	950	2500	2500	228	600
% Currently operational	85	95	65	70	40	?	60

Source: van Niekerk and Still (2002)

VBA Groundwater Consulting conducted a hydrocensus in Uthukela (DC23), Umzinyathi (DC24) and Amajuba (DC25) districts between October 2001 and March 2002. This was largely self-funded to obtain an overall picture of groundwater data and the operational status of handpumps in the districts. The data collected for Amajuba shows that 80% of borehole handpumps were operational, whereas for Umzinyathi only 50% were operational. This is most probably due to two factors: firstly, the Amajuba area had a maintenance programme two years before the hydrocensus while Umzinyathi had none; and secondly, in most cases the pumps in Umzinyathi have a much lower static water level than those in Amajuba, therefore there is generally more wear and tear to abstract the same water. The hydrogeological formations in Uhtukela are mainly sedimentary and dolerite intrusions, whilst Umzinyathi and Amajuba are both basement plus sedimentary and dolerite.

2.7.2 Government maintenance programmes

In the communities visited during the field research there was no clear system for maintenance and repair among end users. In general, if a problem arises with the pump someone from the user community contacts the local Community Development Officer (CDO) or Councillor; however, with no clear reporting system many faults go unreported for long periods of time, particularly if alternative water sources such as springs are available. Once a problem is reported the time lag before the pump is repaired can vary from several weeks to several months or years. The reasons for such lengthy delays are inadequate budgeting, bureaucratic procedures, and the inefficiency of repairing a single pump at a time, which results in councils waiting until there

are several pumps in need of repair in a given area before contracting a company to attend to these. In some cases it may be quicker to apply for a new borehole! In order to avoid the wait, a small proportion of communities may decide to bypass the Government system and contact contractors directly to repair their pumps; however, such cases are not common due to the restrictive cost.

Whether through local Government or not, the cost of handpump maintenance is generally high. Since communities are not responsible for maintenance and repair of their own handpumps they rely on contractors who, in general, live a considerable distance away (Figure 10). As a result, the cost of maintenance usually includes a transport charge of approximately R2.40 per km. Consequently, a replacement rubber seal may cost R20 but the time and travel cost of the nearest competent technician may add R1,000 to the cost. It is primarily for this reason that handpump maintenance programmes cost in excess of R1,200 per handpump per year (van Niekerk and Still, 2002). This equates to approximately R100 per family per year which is still far cheaper than running costs of most piped water supply schemes.

Figure 10: Emerging contractor *Khumalo Mhlungu Borehole Repairs* undertaking handpump maintenance

Most handpump manufacturers in South Africa provide a one year warranty on each of their pumps. However, it seems to depend on who was responsible for installation as to whether this runs from the date of installation or the date of purchase. Some contractors complain that if they report a problem to the manufacturer, they claim that the problem only arose because the pump had not been installed properly. Contractors which are directly linked to manufacturers, such as Howden pumps, are better able to provide replacement pumps should any problem arise while under warranty.

Most District handpump maintenance is contracted out by municipalities and seems to occur in response to infrequent crises such as drought or cholera. A few WSAs now have planned maintenance programmes in place, but these are the exception rather than the rule (Still, 2001a). Most maintenance continues to take place on an ad-hoc basis.

Primarily as a result of the VBA hydrocensus (of 2001/02), the Consolidated Municipal Infrastructure Programme (CMIP) funded a maintenance programme in Umzinyathi District Municipality (DC24) in 2002/03. This had a total budget R3,940,000 (US$525,000) and involved the assessment of 577 handpump-equipped boreholes within the District. Different aspects and geographical areas of the programme were contracted out to several different consultants and contractors. A summary of the achievements of the CMIP maintenance programme is presented in Table 5.

Table 5: CMIP Maintenance Programme 2002-03

Local council	No. of boreholes assessed	No. of boreholes maintained & repaired	Boreholes working or fixed previously (i.e. no maintenance needed)	% of boreholes requiring no maintenance	Not maintained due to poor yield /water quality	% poor yield / water quality etc.
Endumeni	29	13	2	7%	14	48%
Msinga	161	121	11	7%	29	18%
Umvoti	60	25	5	8%	30	50%
Nqutu	327	271	4	1%	52	16%
TOTAL	**577**	**430**	**22**	**4%**	**125**	**22%**

Source: VBA Groundwater Consulting (2003)

Of the 577 handpump boreholes assessed only 22 (4%) required no maintenance at all, this is primarily because very little maintenance had been undertaken in the district in the preceding years. As many as 125 (22%) were not maintained or repaired due to insufficient yield, poor water quality or extenuating factors. This corresponds to almost a one quarter failure rate for all boreholes, which may be because of falling water levels, siltation and stringent water quality standards. The average cost of maintenance and repair per borehole is R6,628 (almost US$900) which seems excessively high but is most likely because 'maintenance' is used to refer to the process of replacing the entire pump, including all components above and below ground and pipes and rods. In general, there is no systematic programme for borehole rehabilitation at district level and this occurs on an ad-hoc basis if at all.

2.7.3 Alternative maintenance systems

Some implementers have introduced alternative maintenance systems to that of local Government. An example of this is the PID VLOM approach where a

Handpump Mechanic (HPM) is trained to maintain and repair certain VLOM pumps and is responsible for a particular geographical area. This is only appropriate where there is a reasonable density of pumps so that the HPM can travel between pumps by bicycle, but the tools and equipment required are light-weight and simple (heavy equipment is often required to repair non-VLOM pumps such as Mono and Orbit). Such systems were originally set up with community financing in mind but are just as appropriate where free basic water is provided, since the cost to the Local Municipality is much cheaper than using external contractors. The recent sector reform whereby sole responsibility for water supply is given to the District Municipalities means that such systems will become harder to sustain due to the need for local management, which LCs are better able to provide, and are likely to operate only on an informal ad-hoc basis.

Figure 11: HPM Sipho Tenzo leading installation of a repaired Vergnet

Where Bucket pumps and Rope and Washer pumps are installed, maintenance and repair can be conducted at household and community level without the need for specialist equipment or training. In some communities each household pays a nominal amount each month to a water committee or to whoever owns the tubewell and this is used for maintenance. In others they simply wait until the bucket or rope needs replacing and raise the necessary funds accordingly. This has the positive effects of low-cost to the user, no or negligible cost to the Government, local empowerment and rapid repair; i.e. ingredients for sustainable water supply.

Figure 12: Household bucket pump repairs

2.7.4 Pump apron and surrounds

Communities are responsible for ensuring adequate cleanliness and drainage around handpumps but many do not recognise the importance of this. The quality of concrete aprons is often poor and in many cases there has clearly been little or no thought to how water should drain away from the pump. As a result, there is often high potential for source contamination, and unsafe conditions for users. Without awareness raising, technical support and community mobilisation this situation is unlikely to improve.

3. Conclusions

The levels of sustainability in the projects visited were highly questionable if the research definition for project sustainability is applied as one in which: *the water sources are not over-exploited but naturally replenished, facilities are maintained in a condition which ensures a reliable and adequate water supply, the benefits of the supply continue to be realised by all users over a prolonged period of time, and the project process demonstrates a cost-effective use of resources that can be replicated.*

- In general, groundwater sources are not over-exploited due to the low rate of abstraction by handpumps; from this point of view water supplies are environmentally sustainable. However, problems of regional groundwater depletion and water quality concerns are potential threats to sustainability that require further investigation.
- In many cases facilities are not maintained in a condition which ensures a reliable and adequate water supply, primarily because the downtime of pumps can stretch to months or years even.
- The benefits of handpump water supplies continue to be realised by all users over a prolonged period of time, in some cases only. This is most common where District Councils have a budgeted handpump maintenance programme in place, or where simpler technologies are employed. In other instances, where maintenance is conducted on an ad-hoc basis, where the average downtime stretches into months or where facilities are deliberately sabotaged, this is clearly not the case.
- In general, the delivery process for new water supplies demonstrates a cost-effective use of resources that can be replicated. The cost-effectiveness and replicability of local Government programmes for maintenance and repair, however, are far more questionable. Maintenance systems and programmes are capital-intensive and could be made much more efficient and cost-effective, particularly in areas with high groundwater levels.

3.1 Institutional and policy issues

Government policy

The biggest single policy issue affecting rural water supply in South Africa is undoubtedly the free basic water policy of 2001. This policy is fundamentally a political decision which was announced prior to any detailed analysis of the economic, financial and governance implications. Approval and implementation of policy without adequate assessment of intended and unintended consequences may result in implementation difficulties or failure in the future.

It is important to recognise that Government rhetoric, for example regarding the superiority of piped water supplies, may have far-reaching and perhaps

irreversible effects, even without the adoption of a formal policy.

The setting of targets for water service delivery, such as those set in the Government's Reconstruction and Development Plan (RDP), provides useful goals. However, if this precludes appropriate structures for sustained operation and maintenance, comprising appropriate budgetary allocation and ongoing monitoring, any gains are likely to be short-lived and the targets remain unachieved, despite Government rhetoric to the contrary.

Local Government capacity

District Municipalities have recently been given the mandate of water service authorities with overall responsibility for urban and rural water supplies. This is primarily a regulatory role and yet many municipalities lack sufficient management and technical capacity to undertake this effectively. Clear guidance in relation to technology choice, contract negotiation and financial management is important to find sustainable solutions, yet this is lacking in many cases.

If local Government is to be responsible for managing and co-ordinating handpump maintenance and repair, it is essential that clear, transparent and streamlined structures and processes are in place to avoid prolonged pump downtimes and to enhance sustainability.

Private sector capacity

Private sector capacity in South Africa is relatively strong and well-developed, especially in manufacturing and technical aspects. Many decisions regarding the delivery of basic services are made by private consultants, many of whom may have the interests of the end-users at heart but also have other priorities. It is important to recognise that private enterprises are profit-driven rather than quality-driven. If the Government wants to provide water as a basic human right it is therefore essential that it provides an appropriate regulatory environment to ensure efficient and effective delivery of products and services by the private sector.

The capacity of some 'emerging' private contractors (i.e. those with majority ownership by previously disadvantaged individuals) may be limited to handpump repair and borehole rehabilitation. If such contractors are to avoid going bankrupt and to develop and expand activities it is important that municipalities provide a steady flow of work opportunities for them.

3.2 Financial and economic aspects

Funding

The predominant focus of rural water supply in South Africa is to increase

access to water for all, ideally at the RDP standard of 25 litres per capita per day within 200m of homesteads. Despite significant Government funding of the rural water supply sector, the targets set remain difficult to achieve, partly due to high expectations and the emphasis on piped water supplies. Simply throwing money at the problem in the short-term is not sufficient, ensuring sustained financing is essential. Careful and flexible planning and implementation will result in more significant long-term gains than racing to achieve targets.

Sustainable financing

Many Local Government authorities cannot afford to provide 6,000 litres of water per household per month as stipulated by the free basic water policy. A larger metropolis such as Durban can afford to provide free basic water since this represents only about 10% of water use. For predominantly rural areas, however, this may increase to about 90%, and resources are likely to be insufficient to support this.

Where communities are expected to pay for piped water recent experiences show that many schemes fall into disrepair and users revert to the use of simpler technologies such as handpumps (if working), or unsafe surface water sources. This may be due, in part, to mixed messages regarding what Government will and will not provide, and insufficient awareness raising and mobilisation at community level.

Handpumps will only remain operational where District Councils recognise their importance as an appropriate water supply technology and budget for ongoing operation and maintenance (O&M) accordingly.

Cost-effectiveness and efficiency

The public-private approach to handpump maintenance and repair used in Kwazulu-Natal results in significant downtime for handpumps since municipalities wait until several pumps in one area require attention before contracting out a private contractor. This ‘fits-and-starts’ approach disadvantages both the handpump users and contractors who may have long periods of inactivity when no contracts are awarded. Contracting out technicians and companies which may be based a long way from the pumps increases the cost of maintenance, due to transportation and time costs. This has a significant impact on the budget of the municipality and may limit the number of pumps that can be repaired in any given time period.

Local technicians can be trained and employed to undertake handpump maintenance and repair at significantly lower cost and reduced response time than contractors. The capacity of such individuals may mean that this is only appropriate where easy to repair, VLOM technologies are adopted, which may not be possible in some hydrogeological settings.

3.3 Community and social factors

Community mobilisation

Where there is an expectation that Government will provide, or should provide, water services, motivation among communities to manage, finance and maintain their own supplies is minimal. Prior to the introduction of the free basic water policy some communities demonstrated proven capacity and willingness to manage and finance their own water supplies. However, this takes considerable mobilisation and is undermined by different approaches by other implementers in the area. Unless adopted as a universal approach, community-based management, and in particular financing, have very limited potential.

Vandalism

Vandalism of handpumps is most likely to occur where they are seen as a clearly inferior technology choice and where there is a low sense of ownership among users. Limited user involvement in selecting and siting handpump-equipped boreholes, and lack of attention to equitable service delivery in a given area may also result in vandalism. Water supplies are also traditionally primary targets for sabotage during political or tribal conflicts.

Maintenance

Where demand for water is high and official mechanisms are slow to respond communities may bypass bureaucratic channels to finance, maintain and repair their own facilities. Such cases are rare in South Africa and are most likely to occur where: a) there are no alternative water supplies nearby; b) response from local Government is negative or slow; and c) the community has sufficient leadership to facilitate independent action. Relative economic levels within the community may also influence this but are probably not critical in distinguishing communities.

Where maintenance tasks are well within the users' financial and technical means they are willing to undertake these tasks autonomously. The use of the Bucket pump and Rope and Washer pump are examples of where technology choice has a huge impact on sustainability, since the users require negligible external support. The key to the success of the bucket pumps is not only simplicity, but clear and unambiguous ownership (especially family ownership). Although the community bucket pumps are maintained, the family pumps are, in general, better maintained.

3.4 Technical and environmental issues

Technology choice

The implementation of new water supplies using handpumps and simpler technologies is seen by many as a regressive step. The argument is perfectly understandable given the historical and political context: *'all white people had running water under apartheid therefore all black people should have it now'*. The perception that piped water supply is the only appropriate and acceptable technology choice has filtered down from political levels to all levels of society. As a result, the handpump is seen by some as a relic of apartheid, and as a symbol, it represents much more than a simple water abstraction method. Such perceptions are difficult to change, yet most sector professionals, including many Government personnel, recognise that the dream of piped water for every South African is, for the time being at least, simply that, a dream. The financial and infrastructural implications and constraints are simply too great. That is not to say that the aspiration is wrong, but simply that the goal is too far at the present time.

As time passes following the free basic water policy and heads closer towards the predicted deadline for the RDP goals, awareness that alternative technologies such as the handpump should not be ignored is only likely to increase. The financial implications of providing free basic water for all are likely to be the deciding factor resulting in the widespread acceptance of the handpump.

Even simpler technologies than the handpump, such as the Bucket pump and Rope and Washer pump, provide appropriate, sustainable water supply alternatives which are accepted by the users. It is important that such initiatives are not rubbished but promoted where groundwater conditions are favourable, at least for the foreseeable future.

Existing handpump models

The helical rotor pumps manufactured in South Africa have proven their worth, especially in areas of deeper groundwater, but that is not to say that they cannot and should not be improved and developed. However, this is only likely to occur if the customer (Government) insists on quality and durability over price.

VLOM handpumps such as the Afridev provide more cost-effective (in terms of local O&M) alternatives to the predominant rotor pumps in areas of shallower groundwater. They will only be successful, however, where there is sufficient recognition by local Government that they are easier and cheaper to maintain and appropriate support is provided to ensure adequate densities of pumps and trained local technicians. New or smaller handpump manufacturers cannot compete directly with the larger established companies and Government intervention is required if alternative models are to be successful. If the predominant contractor approach to repair is continued, just

with different pumps, the benefits of using a different pump will be lost. It is the potential for low-cost maintenance using trained local individuals that gives VLOM pumps their comparative advantage.

Spare parts supply

As long as the public-private handpump delivery and maintenance structure predominates, the supply of spare parts for South African manufactured handpumps is sustainable. The introduction of imported pumps, such as the Vergnet, while based on sound technical grounds, has serious drawbacks in terms of spares supply and is likely to be less sustainable than the adoption of local VLOM alternatives, if available.

3.5 Research implications

The field work in South Africa has provided a unique perspective which differs significantly from the other countries visited for this research. The widely promoted model of local Government regulation and private sector delivery is better established and unlike other countries has been operating for long enough to draw conclusions.

The model of community maintenance adopted in many other African countries may have its limitations, but the South African experience clearly shows that a private sector approach may present as many, though different, difficulties. Although functionality rates of pumps are comparable to, and perhaps better than, those in other countries, the average downtime for broken pumps would appear to be longer. There are, however, no reliable data to confirm or disprove this beyond doubt. One issue that is clear from this and other field visits is that the project approach to rural water supply, be it a project to install pumps or a project to repair pumps, is not a particularly good model to ensure sustainability. There is, therefore, a general need to develop a more programmatic approach to sustainable rural water supplies.

As this is the final field visit for the project the next stage of the research will compare and contrast the findings from the five countries visited and identify the key lessons learnt. It is clear that there is a huge spectrum of approaches and solutions to water service delivery using handpumps. It is also clear that sustainability is affected by actions and issues at all levels from Government policy to community perceptions. For these reasons it is now apparent that the project cannot realistically expect to produce finite guidelines for all levels; the scope is simply too large. However, a range of options and models can now be developed and presented alongside respective indicators for sustainability.

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Appendix 1: Persons met

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David Still, Partners in Development, Pietermaritzburg

Sipho Tenzo, Handpump Mechanic, Nokweja

Appendix 2: Field checklists

Checklist A: National and/or Regional Stakeholders

Key informants (names, positions)**:** **Date of visit:**

Location: **Evaluator:**

Demographic or baseline data

- Data available for project area at Regional/National level?
- Plans to improve data on rural water supply?

Policy

- National Water Policy in place? What stage is it at?
- Does it cover standardisation, local manufacture, gender, cost recovery?
- Is the policy being implemented? What are the main constraints?
- Does it cover monitoring and evaluation?
- Are there assigned institutions for follow-up and back-up support?
- Is the ownership of the boreholes and handpumps clear?

Institutional arrangements

- Organogram of key stakeholders at national/regional level?
- Roles and responsibilities of stakeholders clearly defined?
- Communication and coordination between levels?
- Relationship with local level structures?
- Role of private sector with respect to handpumps?
- Role of NGOs in rural water supply projects?
- Are there phasing-out strategies for support agencies, what are they?
- Are there procedures to be followed if an institution does not perform as it should?

Funding and flow of funds

- How is funding arranged for rural water supply sector?
- How do funds flow to local level?
- How are recurrent costs paid for?
- What are the cost sharing arrangements for handpump projects?

Resources

- Are there adequate resources at national/regional level to fulfil roles?
- What areas are most lacking?

Capacity building

- Have staff at national/regional level received capacity building?
- Do they provide capacity building to local government or other partners?

Checklist B: Local Government and project partner stakeholders

Name of department/organisation: **Date of visit:**

Location: **Evaluator:**

Key informants (names, positions)

Policy

- Are staff aware of national policies? Are these relevant to handpump projects?
- Is there a national or regional policy on standardisation?
- Are staff trying to implement these policies? What are the constraints?
- Is someone monitoring performance?

Project process

- Are water supply activities based on data about coverage or scarcity?
- Is there a mechanism for communities to apply for a handpump?
- Are technologies other than handpumps offered to communities?
- Is a Memorandum of Understanding signed?
- What is the planning and implementation process for handpump installation?
- Who is responsible for siting and drilling boreholes?
- Who is responsible for quality control during construction?
- What do communities contribute towards cost of handpump and installation?
- Who owns the pump? And the borehole or well?
- Is there a formal handover of the handpump?
- What is done to monitor performance of handpumps once installed?

Institutional arrangements

- Organogram for rural water supply?
- Responsibility for mobilisation, installation and maintenance of handpumps?
- Where are handpumps and spares obtained? Where are they manufactured?
- What is the content and purpose of training and what has it achieved?
- How is training phased or linked with implementation?
- How are participants for training selected?
- Are there refresher courses at district or sub-district level?
- Responsibility for training and follow-up?
- Are roles and responsibilities clearly defined?
- What constraints are there to fulfilling roles?
- What is relationship like with national/regional level and communities?
- What is the role of the community in handpump maintenance?

Water supply issues

- What is the design criterion for number of users per pump?
- Is there a standard design for a handpump installation?
- What is the most significant aquifer in the region?
- What type of sources do people use if they do not have access to handpumps?
- What choices were people given regarding water supply technology choice?
- Typical depth of borehole or well?

- Who does the exploration and siting for boreholes? With what equipment?
- What is the success rate of drilling?
- Is there a problem with boreholes (e.g. drying up, siltation etc.)?
- Have any boreholes been rehabilitated?
- Is chemical composition of groundwater tested during drilling? Subsequently?
- Is bacteriological quality of water tested or monitored?

Maintenance

- What are the commonest causes of handpump failure?
- Is there is system in place for carrying out major pump repairs?
- Have communities been given toolkits for maintenance?
- Are they generally carrying out preventive maintenance?
- Do communities know how much it costs to maintain a handpump?
- Are they encouraged to regularly collect money for routine maintenance?
- Can communities afford the full cost of maintenance?
- Who pays for the cost of major repairs (e.g. dropped pipes, new rising main)?
- Are funds available for emergency breakdown (e.g. borehole collapse)?
- Where are spares available? Who buys them? Is there adequate supply?
- Is there a supply chain for spare parts? Could it be improved?

Community and social issues

- What mobilisation work is done with communities for handpump projects?
- Have staff been trained in participatory approaches?
- How is the community organized to operate and maintain the pump?
- Is implementation of water supply linked to hygiene education?
- How do communities communicate with local government and vice versa?

Checklist C: Community/Users

Name of village/location: **Date of visit:**

Distance to district capital: **Evaluator:**

Key informants (names, positions, number of adult males/females)

C1. Project process

- When and how did the community first get involved in the provision of a handpump?
- Were they offered, or did they consider, any alternative technologies
- (e.g. bucket and windlass)?
- Were they clear about what their responsibilities were throughout the project?
- Did they sign a Memorandum of Understanding? What does this say?
- To what extent did they participate during installation?
- Where they involved in the siting of the handpump and if so how?
- Did they contribute towards the cost of the handpump and installation?
- Are they happy with the quality of the work done?
- Who owns the pump? And the borehole or well?
- Was there a formal handover of the handpump? If so how was this done?
- Does the community report back to local government on pump performance?

C2. Institutional arrangements

- Is there a formal organization responsible for managing the pump?
- Who is on this committee or organization (gender)?
- Are roles and responsibilities of organization members clearly defined? What
- are they?
- What constraints are there to fulfilling roles?
- What training did they receive in relation to the pump?
- When was this training received (before or after installation)?
- Are they confident with the skills they gained from training?
- What is the procedure when the pump breaks down?
- Does everyone trust the organization?
- How much contact does the community have with the local water supply
- department?

C3. Water supply issues

- How many households/people use the handpump?
- How much water per day does a typical household use?
- What is the maximum distance users walk to the handpump?
- What is the typical distance?
- What is the handpump water used for?
- Is the taste of the water acceptable?
- Is the handpump the preferred source of drinking water?
- Is it acceptable for washing clothes (no discolouration)?
- What other sources are there nearby? Are these used and if so what for?
- What is the relative distance to alternative sources of water?
- Does the water quality vary at different times of the year?
- Is the quantity of water adequate for everyone or is it rationed?

- Does the quantity available vary at different times of the year?
- Is the pump used all year round? If not, why not?

C4. Maintenance

- How many handpumps are used by the community? How many are functioning at present?
- Are breakdowns frequent? When were the last three breakdowns?
- What is the typical downtime?
- What are the common breakdowns with the pump?
- Have there been any problems of vandalism?
- Who is responsible for repairing the pump? How far away do they live?
- Has the community got a toolkit for maintenance?
- Are they doing preventive maintenance? (Specify what and when)
- Do they have access to spare parts locally? How far do they have to travel?
- Who supplies spare parts?

Financing

- Can the community afford to buy spare parts?
- Do communities know how much it costs to maintain a handpump?
- Do they consider they can afford to maintain the pump?
- Are they regularly collecting money for routine maintenance? How?
- How much money do they have collected at present? How is this stored (bank account, treasurer, livestock, spares etc.)?
- Are there any problems with collection and storage of funds?
- If they are not regularly collecting money do they consider that they can quickly collect enough money whenever the pump breaks down?
- How much have they spent on maintenance in the past twelve months?
- Who would pay for a major repair (e.g. dropped pipes, new rising main)?

C5. Community and social issues

- Is the handpump used by a single community or more than one? Are there any specific groups within each community?
- Have they established any rules with regard to the pump? Is the pump lockable?
- Does everyone in the community have access to use the pump?
- Are there any local taboos or beliefs associated with water or the handpump?
- What has been the impact of the handpump on the community?
- Is the community satisfied with the handpump? Why?
- Have they had any training on hygiene education? Do they understand the link between poor quality water and disease?
- How do communities communicate with local government and vice versa?

Technical data

- Type of handpump (model, make, country of orgin)
- Type of source (borehole, hand-dug well)
- Date of installation
- Depth to cylinder
- Riser pipe material
- Approximate yield (strokes/litre; litres/second)
- Number of strokes to arrival of water
- Observed pump faults
- General quality of construction/installation

- Condition of apron/drainage

Checklist D: Private sector stakeholders

Private pump mechanics

- Where and when did they receive training?
- How were they selected to be trained?
- What did the training comprise?
- How long have they been working as a pump mechanic?
- How many pumps do they work on now?
- Who pays them for work? How much?
- Where do they get spare parts from?
- Can they carry out all repairs? What do they do if it is beyond their capacity?
- Do they have other employment?

Pump or spare part suppliers

- What profit levels do suppliers make? Why do they sell pumps/spare parts?
- Which models of pump do they stock (or hold parts for)?
- How long have they been stocking pumps/parts?
- How long are they ever out of stock?
- How did they initially go into business (e.g. with support from project)?
- Is the business now making a profit without external support or subsidy?
- Do they supply the full range of parts? What parts do they supply and why?
- Where do they purchase these items? Do they purchase them on credit?
- Who are normally their customers for pumps/parts?
- Do they provide technical assistance?
- Do they provide warranties?
- What degree or marketing is used or is needed?
- How does regulation effect them?
- How could business be improved?

Water vendors

- How long have they been vending water?
- How much do they charge for water? What profit do they make?
- What type of people are their typical customers (trade, private, farmers)?
- Do they pay towards pump maintenance?
- What would they do, or do they do, when the pump breaks down?