THE PROMOTION OF THE INTERNET AS A SOURCE OF INFORMATION ON WATER AND SANITATION

by

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Report to the Water Research Commission on the Project

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Abstract

Provision of water and sanitation services in South Africa is at crossroads. Years of neglect in the sector have lead to a backlog of services. On the other hand, there is a growing realisation on the part of the government as to the seriousness of the situation. This renders the efficiency of delivery of services critical.

There has been a general recognition that communication plays an important role in effecting various processes involved in the general functioning of an economy. Conclusions from various researches throughout the world have shown the same to be true for water and sanitation sector.

It was proposed to investigate the potential of the Internet in effecting delivery of services in water and sanitation sector in South Africa. The approach involved promoting the use of the Internet in water and sanitation at two levels; that of the use and that of the source. Whilst connecting water and sanitation organisations to the Internet did not pose a serious technical challenge, introduction of the Internet as a communication tool represented a organisational (and individual) cultural shift with the attendant difficulties.

Low level qualitative and qualitative analysis of the impact of the Internet usage in water and sanitation in South Africa was conducted. The research concludes that while a general scope exists for using the Internet to improve on the delivery of services in water and sanitation sector, steps to enhance the process ought to be taken. The most important one involves improving on the supply side of the water and sanitation communication continuum.

The report makes recommendations on the various generic approaches for inculcating a culture of Internet usage for organisations involved in water and sanitation. The report also makes recommendations for improving on the Internet usage by the primary providers of water and sanitation.

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List of Abbreviations

ARPANET	Advanced Research Project Foundation Network
DO	Dissolved Oxygen
EARN	European Advanced Research Network
HTML	Hyper Text Mark-up Language
IAWQ	International Association for Water Quality
IRC	International Reference Centre for Water and Sanitation
ISDN	Integrated Subscriber Dial Network
ISP	Internet Service Provider.
ITN	International Training Network for water and sanitation.
NCWSTI	National Community Water and Sanitation Training Institute (For South Africa)
NSFNET	National Science Foundation Network
NGO	Non Governmental Organisation
RDP	Reconstruction and Development Programme
TCP / IP	Transmission Control Protocol / Internet Protocol.
URL	Uniform Resource Locator. This is actually refers to an Internet address on the World Wide Web.
WATSAN	An acronym for water and sanitation
WEDC	Water Engineering, Development Centre
WENDY	Water and Environmental Sanitation for Developing Country Needs.
WES	Water and Environmental Sanitation (Services)
WISA-CWSSD	Water Institute of Southern Africa - Community Water Supply and Sanitation Division.
WSSCC	Water Supply and Sanitation Collaborative Council

Glossary

Circuit switching	How the plain old telephone system (POTS) works: The phone company establishes a dedicated circuit across its lines from caller to callee.
Computer Protocol	A language set to certain standard which computers use when executing certain functions as well as communicating with each other.
Interoperability	Ability to use any information appliance to plug into any part of the global information Infrastructure and access any database or communicate through any network in any other part of the infrastructure.
Internet Community	A group of individuals with similar interests that uses the Internet as their only means of communication. The Internet community has been noticed to exhibit traits that are similar to real communities
IP	Internet Protocol, the IP in TCP/IP. The set of rules and standards that govern how packets of data are sent and received over the Internet
Hyperlink(ing)	A way of linking related ideas using highlighted text (the hyperlink) to call up the document that logically follows the active one
Mission-Critical tasks	Tasks undertaken in the operations of an organisation's core business. Generally, they draw their legitimacy from the organisation's mission statement.
Packet switching	How most data networks work. Data is divided into packets, with the destination computer's network address appended to each. Hardware along the network examines these addresses and forwards the packets accordingly.
Peering Agreement	An agreement between Internet service providers with the same capacity to exchange Internet traffic at the same level to facilitate seamless connection between their respective networks.
Routers	Computers on a network that direct data to the intended destination. They are typically located at the end of one network and connect to the next network. This is the hardware that ties the Internet together, by forwarding packets from one network to another.
Search Engines	Computer programs that conduct search over the Internet for particular information. Usually owned and operated by large Internet companies which use their sites for advertising and referral services.

Switches	Same as routers but designed for higher capacity of traffic.
T1	High Speed Internet data carrier lines. Usually made from fibre optics and transmitting data at speeds of up to 10 MB/s. Other classes in this line are T2, T3 and T3.
Technology Diffusion Trajectory	When a new or innovative technology is initially introduced in an organisation, its capabilities are largely untested. At that point, several combinations of the technology mix (old and new) exist. Through experience, the organisation settles at the optimum mix when the transition is over. The preferred technology mix is what is referred to as the technology diffusion trajectory.
Teledensity	Number of main telephone lines per 100 inhabitants of a country.
Underserved (in water and sanitation)	A reference to poor people in developing countries who do not have access to reasonable water and sanitation services both in urban and rural areas.

Chapter 1: Introduction

It was estimated that in 1994, 21 million South Africans did not have access to adequate sanitation facilities. Of this figure, 7.7 million (31 %) were in urban areas. The rest were in rural areas that represented about 85% of the rural population (National Sanitation Task Team, 1995). Further 17.5 million people did not have access to piped water. Although piped water is not the only means of adequate water supply, the percentage population with access to other adequate forms of water supply is insignificant (Department of Water Affairs and Forestry, 1995). The situation calls for a radical approach in the provision of water and sanitation services if reasonable coverage is to be achieved within a short time. South Africa, being a microcosm of the developing countries, faces challenges experienced by other developing countries in supply of clean water and adequate sanitation.

It has been demonstrated that importing first world technologies into developing countries realities does not work (Institute of Water Engineers and Scientists, 1983). There are 2 other options available for the policy makers in the quest for provision of water and sanitation services i.e. research and technology transfer. Whereas continuous research is desirable, it might at times be more cost effective to import existing technology. The Internet has been proposed as medium for technology transfer of water and sanitation information (Dindar, 1997). This research thus concern itself in developing the Internet as a means of technology transfer and communication among the water and sanitation sectors of for South Africa in particular and developing countries in general.

1.1. Water and Sanitation

Investing in water supply and sanitation is considered beneficial to a country's populace. Definite correlation between improved sanitation and water supply on one hand and reduction in infant mortality has been reported (Blum and Feachem, 1983). Other studies suggest reduced morbidity from a host of water related diseases with improved water supply and sanitation (LaFond, 1986). It has also been found that improper sanitation leads to excreta disposal that lacks privacy with the attendant loss in human dignity, especially so in case of women (Okun and Ernst, 1987). This section provides a snapshot of the water and sanitation sector and draws a correlation between the sector operations and effective communication.

1.1.1. Paradigm Shift in Water and Sanitation for Developing Countries since the Water and Sanitation Decade.

The United Nations between 1980 had called the water decade and 1990 following the realisation that water and sanitation coverage in developing countries was unacceptable. At the start of the decade, it was thought that conventional water supply strategies backed by capital injections would lead to higher coverage. Prior to 1980, water supply and sanitation for developing countries were well understood in so far as technical issues were concerned. By the mid 80's, increased investment in water and sanitation

had not produced a commensurate rise in health benefits. Moreover, the rise in coverage was outstripped by the population growth (LaFond, 1986). By the middle of the decade, it became apparent that water supply to developing communities was more complex and went beyond technical issues. The non-technical issues that came to fore were issues were socio-anthropological, environmental, community education and management as well as increased emphasis on sustainable sanitation. Others, public/community participation, hygiene education, water and sanitation advocacy and gender issues. The role of appropriate technologies in water supply also began to be appreciated.

This resulted in increase in the role of effective communication in for sustainable water and sanitation in developing countries since central to the emerging issues in water and sanitation.

The introduction of the Internet has helped improve communication in the fields of research as well as the business and commerce sector. In addition, the use of the Internet has resulted in a significant drop in communications costs. This report identifies the scope for extending these benefits to the field of water and sanitation.

The costs in the provision of water and sanitation services vary from project to project. Communication is a built-in component of all the phases. Whereas direct measurement of the communication contribution to the total value of the project is difficult, quantitative methods developed by Sherman (1993) estimates that effective communication adds up to 25 % of the value of any product or service including water and sanitation. The difficulties inherent in measurement of the value of effective communication make it difficult to justify an increase in the communications budget.

1.2. Research Objectives

Effective provision of water and sanitation services in developing countries involves funding of the various elements of water and sanitation; technical and non-technical. Effective communication plays a central role in successful implementation of water and sanitation projects (Narayan, 1995). It has been suggested that the existing communication continuum in the water and sanitation sector can be improved by incorporating advances in information technology, principally the Internet (Kibata, 1996). However, there are various problems inherent in the introduction of information technology. These range from organisation culture borne of the legacy systems of communication to perceived high costs in gaining Internet connectivity.

The research is centred on a hypothesis that the Internet can be a useful tool in provision of water and sanitation services in South Africa. This hypothesis further states that this usefulness can be achieved through development of organisation cultures in water and sanitation that is responsive to the introduction of the Internet as a means of information dissemination and retrieval.

Thus, the research objectives are: -

- to support South African policy makers and organisations involved in the planning, design, financing, implementation and operation of water and sanitation services with an efficient information service,

- to make available, to South African organisations involved water and sanitation, international information on the topic, and

- to assist in making South African expertise in water and sanitation available world-wide.

1.3. Outline of the Report

The research approach is built around the realisation that at the time the research was formulated, no meaningful information was available over the Internet on water and sanitation. In order to promote the use of the Internet as a source of information on water and sanitation, one had to start by developing a culture of general Internet usage in water and sanitation. At the same time, information on water and sanitation on the Internet has to be cultivated. Only then can the Internet be developed and promoted as a source of information on water and sanitation. With this in mind, the research methodology was designed to consist of 3 phases: -

- the **advocacy phase** in which various organisations and individuals in water and sanitation sector were lobbied into using the Internet as a communication tool,

- the **development phase** where select organisations were given the necessary support to put up their information on the Internet at the same time encouraging them to increase the usage of the Internet as a source of information, and

- the **partial evaluation** phase of the research in which the effectiveness of dissemination and retrieval of the information for the organisations studied was conducted.

The research was limited to 6 organisations that were thought to be important in the water and sanitation sector in South Africa. The evaluation phase was only tested for 1 site and serves only as an indication of the potential of quantitative methods in the promotion of the Internet as a source information on water and sanitation.

The literature is reviewed in **Chapter 2** while **Chapter 3** gives a description of the field activities undertaken and the results obtained.

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Chapter 2: Literature Review

The Internet as a form of communication has existed since 1960 (Smith, 1995). However, its use in solving problems in general and concerned with provision of clean water and adequate sanitation is not as developed (Buckley and Kibata, 1996; Salwen, 1996).

Recent developments in electronic networking through the Internet open up new possibilities for the exchange of information between professionals in the water and sanitation sectors of developing countries. However, information on water and sanitation on the Internet is still scattered and hard to find. Salwen (1996) sees in the Internet a promise for simplifying and speeding up research, networking, and technology transfer.

2.1. The Internet

Internet has been described as a network of computers and computer networks connected through a common language known as protocol (Buckley 1996; Smith, 1994). Internet applications are many and are well documented elsewhere (Buckley *et al*, 1996; Buckley and Hurt, 1996; Kibata, 1996).

2.2. Previous work done on Internet, Water and Sanitation in Developing Countries

Kibata (1996) and Dindar (1997) conducted the pioneering work on the use of the Internet in the water and sanitation sectors of developing countries. The two studies concluded that scope exists for using the emerging Internet technology to promote the provision of water and sanitation services.

In their work, Kibata (1996) and Dindar (1997) concluded that

- there was a lack of appreciation of the importance of water and sanitation in development of a country.
- there is an inter-relation between information supply and demand. Without supply, there was no demand and without demand, there was no percieved supply.
- despite the role played by appropriate technologies in provision of clean water supply and adequate sanitation, there is a lower level research in the sector due to perception that appropriate technology is *inferior* by engineers
- there exists effective, appropriate solutions to technical problems encountered by engineers in developing countries within the developing countries.
- information on water and sanitation exists with but it is not easily accessible to people in need.

- greater access to the Internet in developing countries is a prerequisite to an effective use of the Internet in water and sanitation sectors of developing countries for technology transfer and exchange.

- Internet access to water and sanitation professionals in developing countries is actually higher than previously thought.

Kibata (1996) and Dindar (1997) hence recommended that

- in order to increase access to the information held by the web site (INTERWATER) to sector professional in developing countries, it was necessary to present the web site in popular languages, creation of awareness of its presence in print and electronic media and to increase access to the Internet in developing countries for engineers involved in water and sanitation sectors of developing countries.

- priority be given to inclusion on the site of information on appropriate technology. This may have an effect of stimulating research in this direction that is beneficial to communities in developing countries.

- a listserver that is specific to water and sanitation in developing countries be established to exchange technical views and information among engineers.

- establishment of a parallel project to improve access to the Internet in developing countries.

- standardisation of technical information held by partner organisation in order to ensure logical and effective flow of information among the engineers.

- promotion of the INTERWATER on both demand side and supply side.

2.3. Emergence of the Information Economy

Talero and Gaudette (1996) believe that a new kind of economy, the information economy, is emerging. Talero and Gaudette further argue that the information revolution has created an opportunity to solve the problems of poverty, inequality and environmental degradation in developing countries. One way in which environmental degradation can be solved in developing countries is paying closer attention to water and sanitation hence improving on the water quality of these countries. Talero and Gaudette as have suggested ways in which the opportunity presented by the information revolution could be realised:

- widespread and equitable access to communication and information services through accelerate deployment of national information infrastructure and effective integration into international communication and informations network.

- systematic improvements in functioning and competitiveness of key economic sectors through strategic information policies and systems,

- new ways to use information technology to help solve the problems of human and economic development.

This research attempts to explore a new way of solving the old problems of inadequate water supply and sanitation as per the suggestions by Talero and Gaudette (1996) reported above.

2.3.1. Emergence of Information Economy and Implications for the South Africa.

Knight and Boostrom (1995) see the development of computer networking in Africa and other parts of developing world a unique opportunity to make a major contribution to the developing world's current and future development in ways which will simultaneously advance objectives of sustainable development, capacity building, decentralisation in decision making, and private sector development. However, if the developing countries do not seize the opportunity fast, they stand to be further marginalised.

2.3.2. Emergence of the Information Economy: Opportunities

Sadowski (1997) assert that correlation between information, communication, and economic growth is well known. This is makes usefulness of electronic networks self evident. Electronic networking is a powerful, inexpensive way of communicating and exchanging information. Sadowki (1997) further reports on a latent demand for national and international collaboration that is being realised by electronic networking services that have been noticed in the developed countries. According to Sadowski (1997), this latent demand is caused by such inconveniences such as need to secure large budgets and approval for travel, need to continuously retype long letters transmitted by fax or mail or disruptions caused by delay in mail. The collaboration borne of the electronic networks has led to greater productivity that comes out of the resultant synergy. Further, the collaboration has led to inter-linking of resources.

Sadowsky (1997) further reports that electronic networking is now crucial to the scientific research and development efforts. This networking is reported by Sadowski (1997) to be yielding tangible economic benefits. Sadowski further explains that increase in electronic networking will help improve the live of developing communities through improved effectiveness of development agencies.

2.3.2.1 New Ways of Solving old Problems

Information revolution has created new ways of doing business in developed countries (Drucker, 1994).

Richardson (1997) gives an example of ways in which the Internet is being used to solve the old problem of human development in Chile. In Chile, the Food and Agricultural Organisation's (FAO's) Communication for Development in Latin America Project is pioneering a participatory approach to the development of Internet information and communication networks among the farmer organisations of small-scale producers. This system provides farmer organisations with data on crops, international crop status and market timing, prices, markets (regional, national, international), weather, technical and training information, and information about the various organisations that support their work. The users have full access to the Internet to find other information relevant to their lives and communities (e.g. health, social service, education, etc.), and they can use electronic mail to communicate with other farm organisations in Chile, as well as all the people using the global Internet world-wide. The most important aspect of this initiative is its specific attention to local information needs assessments, and assisting farm organisation personnel with developing the skills necessary to analyse and disseminate information that is locally relevant. This methodology emerged from previous development communication experiences using small format video, print media, and rural radio.

Richardson (1997) further argues that community organisations need instant information on global market prices, negotiation techniques and strategies, analyses of product potentials in various markets, new production and marketing techniques, new transportation systems, and global trade rules. Information that can reduce the costs of transactions and improve prices received at markets (or open new markets) is highly valued. These organisations can and do act as communication conduits or intermediaries, facilitating the flow of information between local people and the rest of the world. The global Internet is one tool that can enhance this flow of information. It is an inexpensive way to communicate and access global information. Local Internet services can be easily managed by well organised local user groups and farmer organisations. Information and analyses can be tailored to local, regional and national knowledge and communication needs and realities. When combined with national and global market information systems, and with the ability to communicate quickly with potential buyers and brokers, local Internet systems become valuable strategic planning and decision making tools. Community information centres and farmers' organisations can also gather information from the Internet and disseminate it via local radio stations, newspapers and other local information sharing networks and tools. For example, daily market prices and agricultural news can be posted at co-operatives, local stores, transportation hubs, agricultural supply outlets and social gathering points. Simple newsletters can be developed using Internet information and distributed to members of farmer organisations. When integrated with other media tools, the Internet can be a powerful information resource and research tool.

2.3.2.2 Jump-starting the Opportunities.

Richardson (1997) reports that current evidence suggests that in order to achieve sustainability and success, Internet projects for rural development (that includes water and sanitation projects) must begin with the real needs of the local community of users. To this extent, the research fulfils this requirements by addressing the needs of the developing communities of South Africa who do not have access to clean water or adequate sanitation. Richardson (1997), further suggests that addressing the real needs of the community requires an approach that catalyses local participation, supports information and communication needs assessment, build awareness of potential Internet uses, helps build communities of users and builds locally managed, and ultimately, self supporting communication and information networks. It also requires attention to capacity building and institutional strengthening for intermediary agencies that serve the population (e.g. NGO's such as The Mvula Trust). At the policy level it requires dialogue with national telecommunication agencies to help transform and liberalise monopolistic telecommunication service environments, which are major impediments to the spread of Internet services in developing countries.

2.3.3. Emergence of the Information Economy: The Challenges

The opportunities brought about by the Internet are wrought with challenges that need to be overcome before full use could be made of these challenges. Some of the challenges were evident during the research phase of the project which is documented in **Chapter 3**. Whereas information technology holds high promise for developing countries, both in economic and human terms, the promise can only be realised if the developing countries take the steps necessary to provide a public policy environment that will attract world-class companies capable of delivering locally at competitive costs the technologies, products, services and content that are the backbone of the Global Information Society (IBM Canada, 1997).

2.3.3.1 Information Redundancy

Information on water and sanitation over the Internet is scattered and difficult to find (Buckley and Kibata, 1996). Several reasons are attributable to this apparent lack of information. The overriding reason for this apparent lack of substantive information is the fact that the art of placing information on the Internet is still evolving. It is to be expected that with time, technology that will organise information on the Internet in a logical order will evolve.

The search engines on the Internet have been an attempt at improving on the dissemination of the information on the Internet. However, this has not always been successful (Salwen, 1996). The result has been that organisation holding useful information on water and sanitation are

hesitant to put it up on the Internet since they are not convinced as to the true value of putting up the Information on the Internet given the apparent confusion on the Internet (Kibata, 1996).

2.3.3.2 Security Risks and Universal suspicion of the Internet

Cerf (1997) reports that the Internet will not evolve if users are not confident about the privacy of their information and transactions on the networks. It is essential that sensitive, personal and proprietary information be protected and made available only in accordance with internationally accepted guidelines. Equally important, individuals, companies and other organisations will not take advantage of the global system unless they are assured of the security and integrity of their information and transactions. This has been one of the greatest challenges to face the development of the Internet. Data security involves the protection of information from unauthorised or accidental modification, destruction and disclosure. Unless individuals, businesses and other organisations are confident of secure communications through the Internet, they will not use it. Thus, before organisations involved in the dissemination of information on water and sanitation are ready to disseminate their information on the Internet, they need assurances on the privacy of their information (Buckley and Kibata, 1996).

IBM Canada (1997) reports that for developing countries, a networked environment will serve not only as the vehicle for delivery of content and services but also as a platform which developing countries can utilise to enter global business, including software development and trans-border data processing. Intellectual property protection is a prerequisite for networking. Without it, the platform will be built more slowly if at all. Without it, less content will be created, and those who do create it will be reluctant to send it over the network. The same applies to substantive information on water and sanitation. As the world shifts towards a more global market and a more open competitive system, private investment will naturally flow to those countries with attractive business climates, and companies will likewise prefer to do business in those countries. Poor intellectual property protection, or an environment that promotes software piracy or results in weak enforcement of intellectual property laws, will seriously impede the ambitions of any country seeking to participate in the Global Information Society (IBM Canada, 1997). It is thus imperative for the Internet community to work out a system of intellectual property protection in order to encourage organisations to avail substantive information over the Internet.

2.3.3.3 Speed of Access and Attendant Costs

The poor telecommunication infrastructure in developing countries poses a challenge to growth and development of the Internet in these countries (Sadowski, 1997). One of the common complaints among Internet users in water and sanitation is that the developed countries not appreciate the difficulty of accessing Internet services in the developing countries. The speed of

information retrieval in Africa is much slower than in say, the WaterAid head office in London. Although Internet access is expanding in developing countries, users do not have access to the same range of high-speed telecommunication lines and phone lines that are available in the North. Internet bandwidth (a function of the size and speed of telecommunication lines) is generally less in developing countries than it is in the North. Low bandwidth translates into longer transmission times, and for many users in developing countries, increased costs (Richardson, 1997).

One remedy for the bandwidth problem, suggested by Richardson (1997) and one that has a relatively minor cost, is to mirror information on regionally located servers that could be managed by local Internet Service Providers. The service providers could gain some much needed revenue, and local users would have dramatically improved retrieval speeds which would encourage use and analysis of the information that is available to them from development agencies.

It may also be noted that in 1997, the packet switching technology on which the concept of the Internet is built on has improved significantly to enable global use of proxy servers that are distributed evenly over the Internet. These servers nowadays enable caching of information on a computer close to the users hence improving on transmission speeds (Cerf, 1997).

2.4. Importance of Communication in Water and Sanitation: Review of Selected Issues in Water and Sanitation Sector.

Buckley and Kibata (1996) assert that while the information on water and sanitation in developing on the Internet is available in insignificant quantities, the little there is scattered and difficult to come by. The proposed solution to this problem was the use of an information clearing house known as INTERWATER combined with institution of proper management regime so as to effect efficient and effective technology transfer and exchange between water and sanitation professionals in developing countries.

Buckley *et al* (1996) demonstrated that use of the INTERWATER site could be made to transfer technology in water and sanitation sectors of developing countries. This was conducted using engineering specifications of various designs of ventilated improved pit latrine (VIPLs). Although the models used by Buckleyetal (1996) involved rather simple technology, the research suggested that it was possible to transfer technology in bulk if proper documentation of the technology was carried out.

Kibata (1996) concluded that the Internet generally and the INTERWATER site in particular have a potential for technical use in water and sanitation sectors of developing countries. Dindar (1996) arrived at similar conclusions. Further presentations from Sadowski (1996), Richardson (1997) and IBM Canada (1997), suggest that wider issues affecting the use of the Internet need to take cognisance of the wider

issues such as individual character of the of the organisation providing the information on water and sanitation.

This section highlight the importance of communication in selected sector issues and draws the possibility of Internet led intervention in improving on the communication hence the delivery of services.

2.4.1. Advocacy and Community Participation in Water and Sanitation Projects.

Gorre-Dale *et al* (1994) define advocacy as the act of lobbying political, religious and economic leaders for support or pleading a cause. Common techniques involve providing information, persuading people there is a problem, which they can solve, indicating possible actions and supporting those in power to take them. Again, central to the issue of advocacy is effective communication.

The Water Supply and Sanitation Collaborative Council has identified advocacy, social mobilisation and programme communication as important elements for improved water and environmental sanitation programmes (Ringkong and Reader-Wilstein, 1993). Advocacy, or raising awareness about sector issues, is important in obtaining the commitment of decision-makers at all levels to improve water and sanitation programming. The general goal of advocacy is political commitment to human development, and the specific objective of advocacy is increased priority for water and sanitation. Most advocacy activities concentrate on three themes, i.e.

- improved programming through communication, mobilisation and participation (IPC),
- environmental sanitation, and
- people and the water crisis.

Awareness raising on key water supply and sanitation issues is needed at local, national and global levels. Gorre-Dale *et al* (1994), agree that there is broad agreement on the aims of a communication strategy in support of sector goals, and forms an integral part of achieving those goals. In that framework, the overall objectives of the communication strategy for water and sanitation are:

- recognition: a broad understanding of the importance and benefits of water and sanitation to the economic, social and physical health of communities,
- efficiency: optimising available human and financial resources, through greater co-ordination,
- effectiveness: full application of the lessons learned during the Decade, and
- participation: maximising co-operation and support, both human and financial.

Gorre-Dale *et al* (1994) assert that communication as practised in advocacy in water and sanitation helps to design sustainable projects. It helps to mobilise people for development action, and to promote co-ordination and linkages. Communication spreads knowledge about successful experiences. It points people to sources of information and advice, education and learning, and planning and decision making. Communication helps to organise and manage systems for exchanging information between rural or urban people, or between technicians, or from planners to grassroots and back from grassroots to planners. Consequently, communication improves the reach and impact of training and extension.

The Internet has the potential to play a leading role in advocacy by acting either as a source of information to be disseminated or merely acting as a tool for communication (Dindar, 1997, Kibata 1996).

2.5. INTERWATER Project and South African Water and Sanitation Sector.

The research objectives intended that this project complement an earlier initiative funded by the International Association on Water Quality (IAWQ). This earlier project has come to be known by the name INTERWATER. Kibata (1996) had concluded that the Internet generally and the IAWQ site in particular had a potential for technical use in water and sanitation sectors of developing countries. Dindar (1996) arrived at similar conclusions.

Buckley and Kibata (1996) assert that while information on water and sanitation in developing countries is available on the Internet in insignificant quantities, the little there is scattered and difficult to come by. The proposed solution to this problem was the use of an information clearing house to be known as INTERWATER combined with institution of proper management regime so as to effect efficient and effective technology transfer and exchange between water and sanitation professionals in developing countries. Buckley *et al* (1996) demonstrated that the site could be used to transfer technology in water and sanitation sectors of developing countries. This was done using engineering specifications of various designs of ventilated improved pit latrine (VIPLs). Although the models used by Buckley *et al* (1996) involved rather simple technology, this research suggests that it was possible to transfer technology in bulk if proper documentation of the technology was done and suggested management techniques instituted.

2.5.1. Why INTERWATER?

The INTERWATER was established in order to find solution to the problem of lack of information on the Internet on water and sanitation. The International Association on Water Quality (IAWQ) and the Water Research Commission of South Africa agreed in 1995 to support the Pollution Research Group (PRG) at the University of Natal, Durban in creating an information gateway, in the form of a home page on the Internet, to be provisionally known as the Water Supply and Environmental Sanitation Services Electronic Network for Developing Country Needs (WENDY).

The IRC International Water and Sanitation Centre, together with the United Nations Centre for Human Settlements (Habitat), the Environmental Health Project (EHP) of USAID, and the Water, Engineering and Development Centre (WEDC) at Loughborough University were invited to become members of an International Steering Committee to guide this development. Following discussion among task force members, it was decided to change the name of the initiative to INTERWATER in order to establish more clearly its connection with the water sector for users of the Internet.

2.5.2. Information on Water and Sanitation available on INTERWATER.

In accordance with its overall goal, INTERWATER is concerned primarily with water supply and environmental sanitation in developing countries. It aims to guide users to sources of information, professional contacts, etc., which are of potential relevance and value to those involved with this field, rather than itself providing substantive information on these subjects. Responsibility for providing substantive information to INTERWATER users rests mainly with the partner institutions, through the medium of their own home pages.

The principal functions of INTERWATER are:

- to provide an up-to-date, structured and user-friendly guide or pointer to sources of information on water supply and sanitation available both from partner institutions and from other sources which are accessible through the Internet,
- to provide an effective mechanism for the dissemination of information by sector institutions,
- to provide an effective channel of electronic communication between sector institutions and professionals in all parts of the world, and
- to promote and propose pilot projects designed to provide selected institutions in developing countries with the equipment, materials, training, etc., required to help them to provide and obtain information through INTERWATER (and other channels).

Additional functions are:

- to develop and distribute protocols, guidelines, standards and manuals defining the rules, procedures and methods of operation of INTERWATER,
- to promote the use of INTERWATER through awareness raising, capacity building and training activities, and
- to promote the expansion of INTERWATER by encouraging and assisting sector institutions to become partners.

2.5.3. Organisation and Membership

INTERWATER operates under the auspices of the Water Supply and Sanitation Collaborative Council as a collaborative network of equal partner institutions guided by an International Steering Committee on which each partner will be represented. The Steering Committee constitutes of a task force of the Collaborative Council for as long as the Council continues to extend its mandate to the INTERWATER activity. The Committee formulates its own rules of procedure and those for the operation and management of the network as a whole.

Any institution wishing to become a partner in INTERWATER must:

- accept and agree to support the goals and objectives of INTERWATER,
- maintain its own home page on the Internet and agree to link this page to INTERWATER,
- be willing and able to participate in the INTERWATER International Steering Committee/Task Force, and
- agree to abide by the protocols, guidelines, standards and manuals defining the rules, procedures and methods of operation of INTERWATER.

2.5.4. Resource Requirements

In accordance with procedures laid down by the Collaborative Council, it is the responsibility of the Co-ordinator, with the support of other Task Force members, to provide the resources required to implement INTERWATER and, if necessary, to mobilise any additional resources as needed.

In order for the INTERWATER initiative to be sustainable in the long term, however, it may be necessary:

- to allow individual partners to charge for information and services provided through their own home pages, and
- to charge a subscription or membership fee to partners to cover the services of the central maintenance team and the work of the International Steering Committee.

Chapter 3: The Promotion of the Internet as a Source of Information on Water and Sanitation

Promotion of the Internet as a source of Information on water and sanitation in South Africa as set out in the objectives of the research, would have been difficult to undertake due to the wide scope. It was decided to adopt a strategy whereby promotion of the Internet usage would be carried out with the role players. The role players would then impart the Internet usage culture to the larger community in the sector. Eventually, it is hoped that grass-root electronic networking would be achieved in this way. The interaction with the role players: -

- advocacy and Internet support for the Mvula Trust,
- advocacy and Internet support for NETWAS,
- advocacy for Internet usage at various water and sanitation forums.
- transfer of responsibilities for maintenance of INTERWATER to the International Reference Centre for Water and Sanitation (IRC) at the Hague.
- advocacy and Internet support for the National Community Water and Sanitation Training Institute.
- lobbying organisations and individuals through the Community Water Supply and Sanitation (CWSS) division of the Water Institute of Southern Africa (WISA), KwaZulu Natal Branch.
- participation in 2 conferences covering various aspects of water and sanitation.

The report thus covers these activities during the project period.

3.1. Support to the National Community Water and Sanitation Training Institute (NCWSTI).

In a follow-up to the links established with NETWAS, Kenya (see **Section 3.3**), it was agreed to work closely with the National Community Water and Sanitation Training Institute (NCWSTI). The NCWSTI is an ITN training network as is NETWAS in Kenya. Increased collaboration between these two organisations and especially through the Internet has the potential to ensure that South African information on water and sanitation gets disseminated to an international audience. In turn, South Africans would be able to access information on water and sanitation from international sources cost effectively.

Preliminary results from the meeting indicate that there is scope for achieving the project objective by increased collaboration with the institute.

3.1.1. Background

The Institute came into being in October 1996, through a directive by the Minister for Water Affairs and Forestry in the white paper on Community Water and Sanitation policy of 1994. It is a non-profit non-governmental institution and has been established under the framework of the UNDP / World Bank International Training Networks for Water and Waste Management (ITN). It is the fifth ITN centre in Africa with the other being NETWAS in Nairobi, Kenya, CREPA in Ouagadougou in Burkina Faso, TREND in Accra, Ghana, and Institute of Water and Sanitation Development at the University of Zimbabwe in Harare, Zimbabwe.

The mission of the institute is

…to build capacity in community water and sanitation sector in collaboration with other key players by empowerment of people through the development of competencies in an efficient and cost effective manner. It is a centre for training trainers.

Its aims and objectives are: -

- developing and promoting appropriate training and capacity building for community based development in water supply and sanitation on a national basis,
- developing curricula, modules and material on a national basis to work towards standardisation and accreditation of water supply and sanitation courses ranging from community capacity building to technical and engineering aspects,
- supporting policy development to ensure an integrated development approach, improved methodologies, and effective planning for targeted training and capacity building programmes for water and sanitation sector,
- promoting and supporting training of trainers from implementing and training institutions and,
- providing support to enhance training capacity of governmental and non-governmental bodies,
- networking and linking with national and international training organisations and offering information support services based on research and data collection,

- undertaking action centred research and piloting of curricula through holding workshops both at the centre and out in the field.

Currently, the institution has 7 full time employees and a core of up to 50 professionals throughout the country from which they are able to draw upon as resource persons. Dr. Abbas Shaker is the Executive Director and the institute is based at the University of the North, Sovenga Campus outside Pietersburg.

3.1.2. State of the Internet and its Usage within NCWSTI

The institute currently has 2 computers that have a dial-up account with a commercial Internet provider. The institute operates 2 separate accounts. There is no LAN or other form of network present within the NCWSTI. NCWSTI is well equipped in terms of other computer hardware.

The Institute did not have a presence on the WWW as at the start of the project period. Therefore, there was no information available about the NCWSTI or from the NCWSTI on the Internet as of that time.

The institute's staff uses the WWW extensively in their research mainly in literature search.

3.1.3. NCWSTI and the Research Objectives.

The support accorded to the NCWSTI can be seen within the context of the project objectives as follow: -

- NCWSTI falls within the category loosely defined in the WRC's project objectives as policy makers, organisations involved in planning, designing, financing implementation and operation of water and sanitation services,

- NCWSTI has several useful international links that with time can avail their cumulative information on water and sanitation to South African organisations and vice versa.

3.1.4. Potential Areas of Internet led Intervention

Following the discussion with Dr. Shaker, following were identified as possible areas of Internet led intervention: -

- assistance by the NCWSTI in transfer of information on water and sanitation from other ITN centres in Africa and the world to South Africa and vice versa.

- being in constant touch with organisations involved in water and sanitation on the ground, NCWSTI is strategically placed to inculcate a policy and paradigm shift with those organisations that emphasised increased Internet usage within the organisations.

- the training of trainers role played by the Institute has the potential to inculcate a culture of Internet usage by the community leaders and the grassroots levels with the attendant advantages of increased Internet usage,

- possible assistance in quality control in so far as proposed training standards by the institute are concerned e.g. Internet based proficiency tests and exams.

- creation and consequent use of Intranets for the core professional involved in various NCWSTI training, development, research and consultancy activities.

3.1.5. Proposed Measures

In view of the possible gains identified in the potential areas of Internet based intervention, following actions were proposed to

- assist in setting up a pilot NCWSTI site on the CCWR computers.

- help produce conference material over the Internet for the coming ITN conference entitled standard setting, quality control and co-ordination for training in the water and sanitation sector

- present a paper / poster and demonstration on the water and sanitation resources available on the Internet during the above conference.

- deliver a seminar / training course to some NCWSTI members of staff to

- impart basic web authoring skills to the NCWSTI staff,

- develop the web searching skills for more efficient search and retrieval of information on water and sanitation form the Internet,

- develop a vision to be adopted and followed by the NCWSTI for Internet strategy,

- advocate for increased use of the Internet between NCWSTI and its resource persons with a view to improving on the general Internet by the people on the grassroots level involved in water supply and sanitation.

- investigate the cost implications of getting and giving publications.

3.1.6. Proposed and Implemented Intervention Measures

The project team initially spent 2 days on the premises of the NCWSTI. The following activities were conducted:

- seven members of the NCWSTI of staff were given training on the rudiments of the Internet.
- two members of the NCWSTI staff were trained on advanced web authoring skills.
- an initial NCWSTI home page was developed and uploaded on to the Internet.

In a follow-up meeting, NCWSTI documents were published on to Internet on a *mass production* basis with a view to providing substantive information on water and sanitation over the Internet. It was proposed that NCWSTI join INTERWATER as a partner. At the reporting time, this recommendation was yet to be effected.

It was argued in the previous report that imparting of Internet and web authoring skills to NCWSTI would form an important first step towards the introduction of grass-root computing beyond the project period. The follow-up meeting could thus be seen as a first concrete step towards the introduction of grass-root computing in the water and sanitation sector.

3.2. Support to the Mvula trust

The Mvula Trust being a leading NGO in Water Supply and Sanitation in South Africa presents a logical start for an advocacy programme for Internet usage in water and sanitation sector in South Africa. The project team was been involved with promoting Internet usage at the Mvula Trust with a view to making available the information held by the Trust to other role players in the sector.

3.2.1. Background

Previously, the following steps had been taken in advocating for increased usage of the Internet at the Mvula Trust and in particular the establishment of a WWW page: -

- In October 1995, the Executive Director, Mvula Trust attended the 3rd Global Forum of the Collaborative Council on Water and Sanitation in Barbados. At this time, the parallel IAWQ project on water and sanitation and Internet was in its formative stages and its objectives were presented to the plenary session where it was adopted as part of a mandated task of the Water Supply and Sanitation Collaborative Council. The delegates, including the Mvula Trust Executive Director, committed themselves to increased usage of the Internet within their organisations.

- The project team made a visit to Mvula Trust in March 1996 during which it was agreed in principle that Mvula Trust will set up a WWW page on the Internet.

- A follow-up visit was made to the Trust offices in April 1996 and Mvula Trust computer operations staff was given a basic course in web authoring.

- In June 1996, the project team was requested to help draw up a letter of motivation for establishment of a WWW site for the Mvula Trust. The letter was to be used in motivating for the necessary funds from the board of trustees. The project team drafted a motivation that is attached in **Appendix 1** for which the funds were approved.

- A pilot page for the Mvula Trust was established in March 1997 on a commercial site.

Thus, the purpose of the last review meeting with the Mvula Trust in May 1997 was to assess progress made and investigate on a need for any further assistance.

The Mvula Trust's WWW page has been established on a commercial Internet site. The current hard disk space limit is 10 MB, which cost R 750 per month. Further, it costs R 250 make any alterations to the pages. The Trust feels that these charges are excessive and unsustainable. This is especially so because the Mvula Trust staff is still honing their web authoring skills hence the need to modify the HTML documents on the server from time to time. In view of this, a less expensive Internet provider was being sought.

The project team was informed that the Trust sees the Internet as tool for supplementing their current operations. One possible area in which they would want expands to include electronic based dissemination of their newsletters.

Mvula Trust is currently co-ordinating a programme on the NGO forum that is currently funded by the European Union. Soon, the project will have an official launch and a parallel launch on the Internet would be desirable.

3.2.2. Proposed Solutions

It is proposed to do the following to address the problems and opportunities identified in **Section 3.2.1** as follows: -

- download all the existing pages from the commercial site and set up a parallel site based at the CCWR. Further changes can then be made on the information on the site without incurring further expenses.

- work with the members of staff from the Trust to improve on their web authoring and Internet site management skills.

- the Mvula Trust will then make a decision as to whether to discontinue the present commercial site or have 2 parallel sites or to maintain the commercial site only.

- conduct an analysis of the usage of information contained in the site. This will be done through a hit and linkage analysis.

Having addressed these problems and opportunities, the project team hope that a culture of Internet usage will have been inculcated into the Mvula Trust as an organisation. Corollary, this will permeate to the other role players in the water and sanitation sector.

3.3. Internet Support for NETWAS

NETWAS is one of the organisations through which the project team would like to forge stronger link with South African organisations with a view to making information on South African water and sanitation available globally and vice versa. NETWAS is a mature water and sanitation NGO based in Kenya but new to the use of the Internet. Interaction with this organisation will provide guidance to the information requirements of mature water and sanitation NGO's.

3.3.1. The Organisation

NETWAS is an indigenous Kenyan NGO and is a member of the ITN (International Training Networks) training centres. Whereas the NETWAS's principal area of focus is training in the water supply and sanitation sector, it also has 2 other areas of focus i.e.

- focus on networking and information services. This service is given in cognisance of the fact that collaboration in water and sanitation is becoming recognised as an important component of enhancing sustainable sector management. In this regard, NETWAS is a member of several networks and has a well-stocked documentation centre available for use by other role players in the sector. The documentation centre holds about 2000 books, trade literature, catalogues, directories newsletters and slides.

- focus on research, advocacy, advisory and consultancy services. Through its research arm, NETWAS offers researched consultancy and advisory services to the sector institutions.

The Centre offers specialised training in the water and sanitation sector to other NGOs, government ministries, development projects and donors.

The centre funds approximately 60 % of its operations through its revenue from services rendered while the other 40% is funded by donors and mainly the Swiss Government. Donor funding is usually project specific. It has a long-term aim of becoming self-sustaining. The organisation has about 30 employees.

3.3.2. Relevance to South Africa

NETWAS has been in the water supply and sanitation sector for over 10 year. Their kind of experience is one that South Africa can borrow from in order for the RDP to succeed in provision of services in water supply and sanitation sectors. When accessed through the Internet, this information would be easily accessible in South Africa. From an institutional point of view, the organisation of NETWAS as a training centre for water supply and sanitation in developing countries is also applicable in South Africa. Lastly, information dissemination as traditionally practised by NETWAS through participatory action and research is also instructive for South Africa.

3.3.3. Terms of reference

The terms of reference for the assistance that was provided were:-

- to review the existing Internet facilities at NETWAS and make recommendations as to their suitability to perform the various functions of NETWAS.
- to help source and evaluate a potential Internet provider.
- to conduct a seminar for the entire NETWAS staff in order to prepare them to use the Internet for improved conduct of their duties.
- to develop a framework for creation of a NETWAS home page on the Internet.
- to facilitate in conjunction with the senior management of NETWAS the development of a vision for the growth of Internet related services within NETWAS

3.3.4. Work Performed at NETWAS

The following 3 sections describe the nature of work done for NETWAS in Nairobi during the review period.

3.3.4.1 Existing Services

Currently, the centre operates a UUCP dial-up from an NGO known as Healthnet for Internet mail only. Mail is retrieved from the host in the USA every 3 hours and stored at Healthnet's servers in Nairobi and delivered to the account holder on demand. No other Internet services

exist. Healthnet has the advantage of being an NGO that provides services to institutions undertaking health work in developing countries. With every account comes an offer of a BBS (referred to as conferences) focusing on health issues in developing countries. The account has the advantage of a low subscription fee of Ksh 800 (about US $ 15) per month. In terms of mail service, this service was judged to be adequate for the time being.

The centre has also acquired the CorelPerfect suite for Windows 95 to ease the process of web authoring. However, none of the centre's machines runs on Windows 95. The centre will soon be upgrading its hardware as a prelude to installation of Windows 95 operating system.

However, there is a need to improve on the existing mail reading and TCP / IP software which was found to be tedious and ultimately wasted valuable time. However, in the medium term, it would be necessary to move to full Internet connection in order to take advantage of the full range Internet services currently available. In the short term, this was made difficult by the fact that the existing phone lines in the area were unstable although the telecommunication authorities in Kenya claim that the lines are digital. Unless that problem is rectified, it may not be cost effective to acquire a full Internet connection.

3.3.4.2 Internet Provider in Nairobi

Currently, there are 3 full-fledged Internet providers in Nairobi and about 20 others offering other dial-up services. The pricing structure of the full Internet services providers tended to be uniform. Thus the choice of the provider was influenced by the project team's previous experiences with the Internet service providers in Nairobi. This provider will host the NETWAS web pages and assist in automation of the documentation centre's database in order to provide the information over the Internet to a global audience.

3.3.4.3 Internet Seminar

The objective of the seminar was to prepare the NETWAS staff to take advantage of the opportunities afforded by the Internet to enhance their performance and productivity. With this in mind, the seminar was divided into 3 sections covering the rudiments of the Internet, basics of web browsing including searching, and an introductory course to web authoring. The last course was limited to documentation staff and others with particular interest in the area. Emphasis was placed on the application of the Internet in the work place in water and sanitation sector.

3.3.4.4 Framework for Development of NETWAS Home Page on the Internet.

There was an immediate need to establish an Internet presence by NETWAS even at a superficial level. This would ensure that at minimum, there was an international awareness of

NETWAS as a source of information on water and sanitation. It was thus decided to use the existing hierarchy of the NETWAS brochure as an initial page progressing into each area of NETWAS's focus areas level by level. However, this is a temporary measure awaiting development of a more comprehensive site complete with search facilities for the information held by the NETWAS documentation centre. The web site has since been established using a commercial Internet Provider in Nairobi.

3.3.4.5 A vision of NETWAS and the Internet.

For the purpose of the evolution of the vision, the project team divided a time frame for growth of the use of Internet within NETWAS into short term (within 1 year), medium term (1 - 3 years) and long term (beyond 3 years). It may be noted that these definitions of terms do not strictly conform to the standard definition. This is due to the fact that change in technology in so far as the Internet is concerned is much faster than other technologies. Thus, the vision evolved was as follows: -

- In the very short run, the project team saw the continuation of the existing UUCP dial-up services from Healthnet. An initial home page was also to be developed immediately and lodged with the preferred Internet providers. This will be logically followed by full development of the page to provide useful information.

- In the short to medium term, there will be an evaluation and monitoring of the impact of the site on the operations of NETWAS and assess how the site contributed to the overall operational objectives of NETWAS. It was also suggested that a workshop should be held say in 18 - 24 month’s time, to review the process of monitoring and evaluation.

- In the medium term, an endeavour will also be made to market the information held by NETWAS over the Internet where techniques such as price discrimination would be applied appropriately effectively enabling the information to be free or available at nominal cost to developing countries and at the economic price to the developed countries.

- In the long run, the project team saw an emergence of NETWAS as a leader in provision of information on water supply and sanitation in developing countries. To this end, it may be necessary for the NETWAS to lease a subnet from a local Internet provider to enable all the data maintenance and management to be performed in-house. However, this last aspect was not conclusive and a recommendation was made that more deliberation be done on this point.

3.4. Participation at the 23rd WEDC Conference in Durban, South Africa.

Water Engineering, Development Centre (WEDC) based in Loughborough, UK hosts a conference in either Asia or Africa on water and sanitation every year. WEDC is one of the world's leading institutions concerned with education, training, research and consultancy for the planning, provision and management of physical infrastructure for development in low- and middle-income countries.

The 23rd WEDC was held in Durban between the 1st and 5th of September 1997 at the International Conference Centre (ICC). The theme of the conference was *Innovations and Partnerships*. The project team participated in the conference through an exhibition of the INTERWATER and other Internet based initiatives for water supply and sanitation in developing countries. The exhibition consisted of 2 size A0 posters and 2 computers connected to the Internet in the foyer of the main conference hall. The team was also able to participate in other conference activities such as exhibitions, presentations and technical tours. The team also offered e-mail services on request from the WEDC conference organisers.

3.4.1. INTERWATER Exhibition and Demonstration.

The exhibition was conducted with an aim to popularising the use of Internet in water supply and sanitation sectors of developing countries and South Africa in particular. A previous survey by the project team had concluded that one of the greatest hindrances to use of the Internet in water and sanitation sectors of developing countries is lack of a suitable site which could be used a starting point before proceeding on a substantive information search. The INTERWATER site provided a useful start to any information such over the Internet hence the decision to conduct the exhibition using the INTERWATER. A copy of the posters on exhibition is included in **Appendix 4**.

Typically, an interested person would visit the stand where they would be invited to go through the promotional material. They would then be briefed on the essence of INTERWATER and any further clarification of their interest. The person would then be taken on a live demonstration of the site. At that point majority of the people expressed an interest in INTERWATER either as a starting point for their search of information on water and sanitation over the Internet or as an institution wishing to join as a partner. The first category of enquiries was referred to the INTERWATER URL which was sent to them immediately by e-mail while the second group was referred to the INTERWATER task co-ordinator.

A live demonstration of the INTERWATER partner sites was also given on request. Occasionally, the visitors to the stand would be allowed to *surf* the Internet for information on water and sanitation depending on the prevailing traffic conditions.

The stand was well received recording about 70 visitors daily (the conference had 420 registered delegates). A number of the visitors to the stand expressed a wish to have the INTERWATER presented at a plenary session together with other Internet based initiatives.

3.4.2. E-mail Services

The conference organisers had been previously approached with a proposal to let the project team provide e-mail services to the participating delegates. However, due to restrictions with the networking services, this was not possible. However, some of the conference delegates approached the conference organisers requesting temporary e-mail addresses. Apparently, it has become a norm for conference organiser in developed countries to provide temporary e-mail addresses to participating delegates in a conference. The conference organisers in turn approached the project team to provide the services. Temporary e-mail addresses were set up for those requiring addresses at a fee of R10 to set up an account and thereafter a charge of R 5 per minute of computer time. The charges were necessary to discourage misuse of the computers that were primarily to demonstrate the use of the Internet in water and sanitation sectors of developing countries. However, it must be emphasised that the project team considers e-mail being an integral part of the Internet (see second progress report to the Water Research Commission project number 735). Thus any application of the Internet in water and sanitation must include use of the e-mail. Thus, the project objective of promoting the use of the Internet in the water and sanitation was, in a way, catered for.

3.4.3. Technical Tour

The project team toured Efaya water scheme as part of the conference technical tour. This water supply project had been previously used in evaluation of the potential effectiveness of the prototype Internet based Information provider that was then WENDY (Kibata, 1996). Some of the solutions suggested from the study have since been instituted and the project is about to be handed over to the community.

3.4.4. Contacts Established

Various people made enquiries on INTERWATER. It is difficult to assess the seriousness of the inquiry and the probable impact of the inquiry. The international links are particularly important in that they would serve as users of South African expertise in water and sanitation and at the same time availing their experiences. Inquiries were received from the following institutions: -

- MEWD, Zambia
- Centre for Disease Control and Prevention, USA
- Murdoch University, Australia

- International Committee of the Red Cross, Nairobi
- Development Workshop, Angola
- Lawrence Berkeley National Laboratory, California, USA
- Glover Development Engineers, South Africa
- Department of Water Affairs, South Africa.
- United Nations Development Programme, Zambia.
- Leon Foundation, South Africa.
- EuroConsult, The Netherlands

3.5. Participation at the 9th ITN Conference in Pretoria, South Africa.

The 9th ITN Africa conference was held in Pretoria in December 1997. The ITN is a global programme established under the aegis of the United Nations Development Programme and the World Bank Water and Sanitation Programme, with centres in Africa, Asia and associated countries in Latin America. The ITN is a network of professional organisations, established to provide qualified advice, information and training in the water and sanitation sector. The ITN Africa centres have developed into a network of non-profit-making organisations.

The overall theme of the ITN Africa Conference was Standard Setting, Quality Control and Co-ordination for Training in the Water and Sanitation Sector. The conference aimed to enable the speakers and participants to share their experiences on the theme.

The project team displayed posters on INTERWATER. A computer with a live link to the Internet was used to raise the awareness of the participants on the various source of relevant information on the Internet.

The conference attracted about 120 delegates, 70 % of whom were South African. About 90 % of the delegates were able view the demonstration during the course of the conference. Projected impact of the conference is qualitatively analysed in **Chapter 5**.

3.6. Development WWW page for Various Key Organisations in South African Water and Sanitation Sector.

The Mvula Trust and Umgeni Water are key role players in the water and sanitation sector in South Africa. The project team was involved in the establishment of the Mvula Trust web presence to the extent outlined in **Section 3.2**. On the other hand, the project team had invited Umgeni Water into the membership of the

steering committee of the original IAWQ water and sanitation Internet project (then WENDY, now INTERWATER). Establishment of a web site was a prerequisite to joining the project. At that point, it was suggested that the Umgeni Water should establish a presence on the web.

Umgeni Water's page was created in November 1996 while that of the Mvula Trust was established in April 1997. The challenge is now to make the information contained in these 2 sites useful and at the same time impart a culture of using the Internet for information dissemination and retrieval to other organisations in the sector.

Web site for the NCWSTI was established in November 1997. This was after some amount of lobbying. In lobbying for acceptance of the use of the Internet at the NCWSTI, several lessons were learnt. These are documented in **Chapter 5**.

3.7. Lobbying at the WISA Community Water Supply and Sanitation Division of the KwaZulu Natal Branch.

The aim of the lobbying at WISA was to inculcate a culture of Internet usage by the sector professional through a professional organisation. It was hoped that the culture so acquired will enable the sector professionals perform their duties more efficiently. The process of lobbying at the WISA was a 3-tier process: -

- the project team joined the WISA Community Water Supply and Sanitation Division (CWSSD) and thereafter helped establish the communication subcommittee of the division.

- the project team made oral presentations at CWSSD quarterly workshops. In addition, the team demonstrated the use of INTERWATER at the annual general meeting of the branch. Other water and sanitation initiatives were also covered. This went on throughout the project period.

- the project team helped establish a WISA community water supply and sanitation page on the Internet. Through this page, the division was able to place notices of meetings, minutes and other articles that were of particular interest to the members.

The CWSSD has about 200 members. It is estimated that the sessions that the project team interacted with the CWSSD, about 90 % of the members had had some form of exposure to INTERWATER in particular and the use of the Internet in water and sanitation sector.

The conference resolved to set up a WWW page on the Internet, which would serve the purpose of co-ordinating the Internet activities of the various member institutions. The project team was asked to assist in the process.

Chapter 4: Technology Transfer

During the review period, technology transfer took the form of conference material and academic works in addition to Internet skills transferred abroad. The technology transfer carried with it an element of promotion of the Internet as a source of information on water and sanitation.

4.1. Poster presentation

A poster titled *Water Supply and Sanitation for Developing Countries; Information Provider* was presented at the WISA '96 conference in Port Elizabeth from 20th to 23rd of May 1996.

4.2. Conference Papers

A paper titled *INTERWATER; A Gateway to Water and Sanitation Information on the Internet* was presented a conference titled Environment Technology; Principles and Practice in Merdeka University in Java, Indonesia during the June 1996. The paper is attached in **Appendix 2**.

A paper titled *Water and Sanitation for Developing Countries: Internet Based Information Provision*, was presented to the 23rd Annual Symposium on Application of Information Technology in Engineering organised by the Information Technology Division of the South African Institute of Civil Engineering. The theme of the symposium was *Empowerment through Application of Technology*. The paper is attached in **Appendix 3**.

A paper titled *Can the Internet be a useful tool in For enhancing effective delivery of services in Water and Sanitation Sectors of Developing Countries?* was presented to the WISA `98 in Cape Town in May 1998. The paper is attached in **Appendix 4**.

4.3. Demonstrations

A demonstration of the INTERWATER project was performed at the IAWQ conference in Singapore in September 1996. Two more demonstrations were carried out at the WEDC conference (see **Section 3.4**) and at the ITN Africa conference (**Section 3.5**).

4.4. Skills transfer

Internet skills were transferred to collaborating organisations in Kenya as described in **Section 3.3** during the project period.

4.5. Thesis / MScEng projects

Two master's theses were accepted for examination at the University of Durban-Westville. These were: -

- *Water and Environmental Sanitation for urban communities in developing countries: Information server* by N. Kibata, and

- *Rural Water Supply and Sanitation: A Transfer of Technology through the Internet* by M. Dindar .

Chapter 5: Discussions and Conclusions

Various issues concerned with the promotion of the Internet as a source of information on water and sanitation has 2 faces to it i.e. the demand and the supply side. Thus promotion was built around stimulating a demand for information on water and sanitation in electronic format and encouraging holders of the information to put it up in electronic format. The chapter discusses the extent to which the research objectives as set out in **Chapter 1** were achieved. The objectives were: -

- to support South African policy makers and organisations involved in the planning, design, financing, implementation and operation of water and sanitation services with an efficient information service,
- to make available, to South African organisations involved water and sanitation, international information on the topic, and
- to assist in making South African expertise in water and sanitation available world-wide.

5.1. Generic problems / Issues Associated with the Use of the Internet as a Source of Information on Water and Sanitation.

Results of the research show that it takes time to change an organisation culture, to using the Internet as a source of information and a medium of information dissemination. This is slow and needs time to

- demonstrate
- convince
- budget for capital and recurring expenditure
- acquire equipment
- evolve information dissemination and acquisition strategy
- implement

In order to achieve the project objectives, then the above steps need to be taken cognisance of and plan accordingly.

Further to these, generic issues/problems that arise with respect to the Internet based paradigm shift are:

- who owns the information once it is availed over the Internet

- can such information be marketed and sold.
- if the information can be marketed and sold, how? who are the prospective customers?
- funding and
- sustainability.

5.2. Discussion of the Lessons Learnt in promotion of the Internet as a Source on Information on Water and Sanitation

Further efforts to promote the use of the Internet, as a source of information would be desirable. From the research, various useful lessons have been learnt which would be useful in future initiatives to promote the use of the Internet a source of information on water and sanitation. The lessons have been varied and are on both the demand and supply side of the information continuum.

5.2.1. General Considerations

In order to develop the use of the Internet in South Africa as a source of information in South Africa, the following have been identified as the general consideration imperative to the success of the task

- Internet infrastructures hence access should be improved for the majority of developing countries. These are the countries whose experiences in water and sanitation would be useful if availed on the Internet. If need be, the countries should be supported in development of policies that enhance rather than stifle the growth and development of the Internet.
- structures to introduce *grass-root electronic* networking need to be put in place through out South Africa. This would encourage development of the Internet as source of information for communities that would be direct beneficiaries of the information retrieved and disseminated from the Internet.
- a network of linked sites containing substantive information on water and sanitation needs to be established. Presence of useful information on the Internet can be used as a strong motivator in the use of the Internet. The existing INTERWATER based network can be used to jumpstart the establishment of such network.
- South African organisations ought to be encouraged to avail the information they have on water and sanitation on the Internet. This was partially addressed in the course of the research but scope exists for more work.

5.2.2. The Lessons

Demonstration: This forms the initial part of the promotion process. It is very important because it is at this point that the client and the promoter bonds. This lesson was very important because it bears similarity with the new paradigm used in the provision of water and sanitation services where the promoters have to bond with the community. This is usually a prerequisite to a successful study of the problem water and sanitation problem affecting the community and subsequently, providing the solution.

Financing profile and capital expenditure: Most of the organisation that the project team undertook promotion work with was *Internet ready*. This means that the necessary infrastructure to put up the information on the Internet was already in existence but for different reasons. The organisations had computers, phone lines and in some cases, some limited form of Internet capability. However, rarely did the organisations have the right software. Usually, the software was limited to post Windows 95 word processors. However, in case of role players on the demand side, usually small organisations, the costs were significantly more. This is due to the fact that the organisations started by purchasing modems on the minimum. The next step was sourcing an Internet service provider, which was not very expensive. However, it involved some major decision making steps. Thus, on it may be concluded that while the actual cost of using the Internet as a source of information were low, changing the organisation culture came at a considerably higher cost. It should also be pointed out that the costs for organisations on the supply side of the water and sanitation continuum will be significantly higher because a person needs to be trained to manage and maintain the information dissemination process. The level of training and amount of time spent will depend on the extent to which the organisation concerned intends to disseminate its information over the Internet.

Evolution of information dissemination and acquisition strategy: From **Chapter 2**, similarities were drawn between the traditional medium of communication and the Internet. The differences were also drawn. This similarity was noticed in the advocacy phase of the research project. It emerged that the organisations concerned warmed up quickly to strategies that strongly identified with the organisation operational goals and strategies. This has the advantage of ensuring continuity in the information provision in case the organisation in question decides to eventually change to electronic based information acquisition and dissemination.

Implementation and Maintenance: This phase tended to be relatively easier. The lesson learnt was that once on organisation took a high level decision to disseminate and acquire information using the Internet, the implementation moved relatively fast. The presence of the project team was limited to instances where the organisations felt that they did not have the resources to carry out the implementation. In some other instance such as with Umgeni Water, the organisation took hired out the services of commercial firms to undertake the implementation. The lesson learnt here amplified the

fact that in introducing a new information dissemination regime, it is important to ensure minimum level of disruption to the existing structures within the organisation.

5.3. The Impact of the Internet on Delivery of Services in the Water and Sanitation Sector in South Africa

It has been established that communication forms an integral part of a vibrant water and sanitation project within the context of the new paradigm in water and sanitation (see **Chapter 2**). Enhanced communication methodology translates into a more efficient delivery of services in the water and sanitation sector. It is within this context that this section seek to discuss the likely impact of the research project both in the short to medium term and in the long run.

5.3.1. Short and Medium Term Impacts.

Demand side: On the demand side of the information continuum, a basis has been established through the project upon which role players can piggy-back on in order to obtain information from the Internet. However, 2 reason will act counter to the effort. Substantive information on water and sanitation is still lacking on the Internet. Whereas reasons are for the absences are varied, it might be discouraging for organisation to establish the necessary structures to acquire information from the Internet and still find it inadequate. The likely impact is that the organisations will use Internet for communication purposes only. This in itself is a positive impact in that lower communication costs can free up resources for use on other facet of water and sanitation. However, there is a danger that the organisations might be disillusioned and altogether give up the trying. The other likely hinder is latent resistance to change a medium level management. The research concentrated on lobbying high level management in changing the information acquisition and dissemination strategy. Once the necessary change in high level management had been secured, it was assumed that the processes normally followed by the management in inducing cultural change would necessarily be effective. This might not always be the case.

Supply side: On the supply side, it is expected that the quality and quantity of information will increase with the demand. In a way, this would be a sustainable manner of information on the Internet, i.e. demand driven. The lesson learnt is that in order to improve on the water and sanitation information available over the Internet; a demand will have to be simulated.

5.3.2. Long Term Impacts

In the long run, Internet usage in water and sanitation will be influenced by the emerging paradigm in Internet computing. The emerging paradigm around computing has been shaped up by the recent developments in the Internet technology. Thus, it can be concluded that the long term impact of

Internet usage in water and sanitation would be a radical departure from the traditional way of doing things in the sector. This will not be just in information dissemination but also in operations.

5.3.3. Projected Organogram of the Impact of the Advocacy Coverage for Target Secondary Audience

Section discusses the projected coverage and make out the possible impacts on the Internet usage. **Table 5.1** shows an organogram of the advocacy activities undertaken, the secondary audience that was targeted, the projected impact and the Intervention necessary in order to realise the projected impact.

Table 5.1: Projected organogram of the advocacy coverage and recommended Intervention

Event	Target Secondary audience	Projected impact	Intervention needed
Advocacy work at the WISA-CWSD, KZN Branch	water and sanitation professionals.	enhanced Internet usage by sector professionals	none
Internet Support for The Mvula Trust	other role players, NGOs, communities, etc	informed decision-making, improved communication.	Internet Kiosks
Internet Support for the NCWSTI	sector professionals, policy makers, communities	informed decision-making, improved communication.	Internet Kiosks, universal WWW access
Umgeni Water	sector professionals	enhanced Internet usage, better communication mechanism, improved availability of project documentation	none
NETWAS Consultancy	all information receipients.	efficient technology transfer mechanism.	none

Chapter 6: Recommendations

From the research, it has been demonstrated that in order to promote the use of the Internet as a source of information on water and sanitation in South Africa, the 2 facets of the sector have to be addressed. These are: -

- the demand, and
- the supply side of the information on water and sanitation.

Steps should be taken to enhance positive grass-root networking among the communities both directly and indirectly. This way, a community that is positively disposed towards using the Internet as a source of information on water and sanitation is established. It should be noted that this attempted in the project although it fell beyond the scope. Influencing the role player was as far as the project went. On the other hand, it is imperative that policies that encourage growth of the Internet are fostered in South Africa and other developing countries that constitute the information source. To this end, the report makes policy recommendations that are deemed to be necessary.

It should be noted from **Chapter 5** of the report that policy shift the supply side of the information continuum is usually much more difficult than on the demand side. This impact of this problem is made worse by the fact that the continuously depressed supply of water and sanitation information on the Internet. To this end, the report recommend proactive measure that will include financing profiles to enable organisations involved in provision of water and sanitation services to avail the information on the Internet.

6.1. Recommendations for Improvement of the Supply of information on Water and Sanitation on the Internet.

The research recommends supports for all the organisations involved in water and sanitation to publish their information on the World Wide Web. It should be noted that recent improvements in web publishing technology have made it possible for organisations to publish their documents to the web directly from hard copy. The organisations are likely to be holding their information in hard copies rather than electronic copies. With basic investments in scanners and appropriate software, this wealth of information can be converted to portable information fast. The documents will include manuals, project reports, documentation of lessons, brochure etc.

It is recommended that such an initiative be carried out on a project basis and in phases. The first phase would involve taking an inventory of all the organisations that fall under this category. The final phase would involve *mass processing* of the information held by the organisations to the extent that the organisations deem prudent and necessary for their operational goals. The information so processed would

then be published on the Internet. The project costs could be borne by sponsors for a certain period after which the organisations would be responsible for the maintenance.

It should be noted that the steps recommended in this section were noticed to be effective in the research as reported in **Chapter 3**.

6.2. Policy Support for South Africa, Africa and other Developing Countries: Recommendations

The policy support envisaged for the national, regional and international organisations involved in the water and sanitation are outlined here. It should be noted that for an effective policy on water and sanitation, combined efforts by all the role players in the water and sanitation sector is necessary.

- encourage more agencies to become involved in the INTERWATER Initiative which is co-ordinated by International Reference Centre for Water and Sanitation and communication technology stake holders and other regional networking forum. It may be noted here that INTERWATER was originally an initiative based in South Africa.

- achieve commitment among development agencies to collaborate on a clear strategy for information and communication technology support in developing countries in order to improve planning, resource sharing.

- improve the availability of information on the existing water and sanitation projects

- improve access to technical skills

- improve information and communication technology for use in developing countries, which can include network administrators from the developed countries becoming familiar with the specific challenges faced by Internet users in developing countries,

- increase support for the development of local content and the conversion of existing standalone computerised information systems to networked access, integration with decision support systems, and develop new information-based services that exploit local potential.

- develop and publicise key pilot projects. This has partially been achieved through the research but scope does exist for building on the foundation that has been laid.

6.3. Recommendations for Increased Grass-Root Electronic Networking

This report recommends activities to water and sanitation stake holders in gaining access to, and developing creative uses for, Internet services. In this way, the water and sanitation professionals would

have community-managed projects that are run using informed decision making. Specific recommendations are: -

- promote policy and regional co-ordination of Internet strategy for rural development
- establishing more pilot projects as undertaken during the project.
- extending the communication for development approach as practised by advocacy practitioners in the water and sanitation practitioners to incorporate the use of the Internet.
- support efforts to liberalise telecommunication policies in developing countries. This is because ultimately, the success of Internet usage in South Africa will depend on the availability of substantive information on water and sanitation from other developing countries.
- support local Internet entrepreneurs and other service providers in developing countries
- assist stakeholders in advocating for Internet service provision and telecommunication infrastructure and policy improvements
- orient existing Internet information services to users in developing countries
- support rural and agriculture educational sector Internet capability
- provide Internet awareness building and demonstration
- support rural and remote infrastructure development
- support creative Internet applications and information services for rural development

6.4. Recommendations for Further Research.

In the report, it was noted that a probable scope exists for quantifying the impacts the use of the Internet on the water and sanitation sector. This report recommends further research into the method and full development to enhance its potential. It has been established that potential exists for enhancing the benefits of the Internet and adopting them in the water and sanitation sector. If this mechanism were well understood and perhaps quantitatively so, then strategies for maximising the benefits would be drawn out from an informed point. Positive results from such a study would justify any investment in the Internet technology by policy makers in the water and sanitation sector. Further, increased investment on the Internet has the potential to improve on the supply side of the water and sanitation information continuum that the study has established.

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Appendix 1

Motivation for the Mvula Trust to set up a WWW home page on the Internet

A need for Mvula trust to set up a home page on the Internet arises as a natural consequence of growth in the magnitude of the operations of the trust. By establishing a presence on the Internet, the trust stands to further its objectives in various ways.

1 Background to the Internet

The Internet has come into vogue in the last four years. It is also increasing rapidly in size. In 1992, there were 10 000 computer networks that made up the Internet. By August 1995, the figure was estimated at around 30 000 and predicted to reach 100 000 in the year 2 000 (Wilson, 1995). One of the main reasons for the speed at which the Internet is growing is the ease of connection. In countries with Internet connectivity, entrepreneurs saw a business opportunity and established their own computer networks known as *local providers*.

1.1. Definition

The Internet is a worldwide network of computers and computer networks which transmit data in digital form over normal telephone lines. Using the Internet costs about as much as a local telephone call and a subscription cost to the local Internet provider. These charges vary from country to country. In developing countries telecommunication and Internet services tend to be expensive but in developed countries same services are cheap a reason being the higher number of subscribers in developed countries lowering the break-even price. The Internet is a decentralised network. No single organisation operates or owns it. It is essentially a network of networks governed only by a set of protocols which specify how messages must be formatted or routed. This task is accomplished by the Internet Architecture Board (IAB) (Smith, 1994).

Although the Internet is very extensive, it is not the only channel of electronic communication available. There are other international networks and electronic channels that work independently of the Internet. However, the Internet is the biggest of the networks

1.2. History of the Internet

The Internet began in 1960 with the United States Department of Defence. The Advanced Research Projects Agency (ARPA) developed the first network of computers called appropriately ARPAnet. It was largely developed to support the space programme and its race with the Soviet Union. The USA government continued to experiment with this network for several years. Around 1980, two networks were developed at universities called Usenet and BITNET. These networks linked hundreds of computers but had nonstandard designs that restricted their growth to the general population (Wilson, 1995).

In 1986, the National Science Foundation (NSF) linked five supercomputer sites across USA to promote research work. With only five sites available, researchers would have to travel each time they needed access to the supercomputers. The NSF decided to create their own network, NSFNET, using regional

networks that connected schools and research sites in the same area (Engst, 1994). The NSFNET was the springboard for the addition of networks that currently comprise the Internet (Wilson, 1995).

The USA is a leader in the development and use of the Internet and is playing an active role in planning the future of the Internet. Some US $ 1 150 million were allocated in 1991 over five years to develop the National Research and Education Network (NREN). This *information superhighway* will provide a highspeed network needed until the twenty first century (Smith, 1994).

1.3. Internet applications

The Internet has several applications. Wilson (1995) summarises the major applications of the Internet below:-

- **Electronic Mail (e-mail)**- E-mail was one of the original applications created for networks. Very simply, it is the direct transfer of typed messages to any person with access to the Internet. E-mail allows almost instantaneous delivery of messages across the world. A further advantage of e-mail is that one can retrieve and reply to messages at leisure. Use of e-mail (and most of the other Internet based resources) has an environmental implication in that the amount of paper needed for information transfer is reduced. Different e-mail systems have various useful functions. Some systems have a *talk* feature allowing users to instantaneously see what the other person is writing and respond. Other systems can attach data or image files to the message. *See-you-see-me* feature of the E-mail enables instantaneous audio-visual communication between two persons. *Internet Relay Chat (IRC)* enables more than three people to hold an *electronic conference* where all the participants can view what each one of them is typing into the computer.
- **File Transfer Protocol (FTP)** is one of the most useful applications in the future of the Internet. FTP is used to transfer files or programs from one computer to another relatively quickly. This application is particularly useful because it allows the transfer of files across machine and language barriers. Each network around the world usually has a list of files or programs available to the public. Using FTP, the user can copy any file to their computer or send files to a remote computer. Examples of the files that can be copied using FTP include executable programs, data files, or even image files.
- **Telnet** is a simple application used exclusively for logging on to remote networks Telnet allows connection to any network around the world, however, each network usually has a security password that only permits guests limited access to its resources.
- **Usenet Newsgroups** - are round tables of dialogue being discussed on over 11,000 topics. The exchanges of information, called strings, start with a *posting* being made and the multiple responses to it. Most discussions are completely interactive. Some newsgroups are not interactive, however, and only provide periodic updates to the related topic. Since there are over

11,000 newsgroups in existence, most users subscribe to only a few. As the need or desire arises, new groups are created almost daily.

- **Discussion Groups** are often referred to as listservers or mailing lists. Discussion groups are written exchanges using e-mail which are either moderated or unmoderated. A list owner will invite people to join their list and any messages that are sent to the list will be copied to all subscribers across the world. This application allows for open discussions on many topics with people of varying backgrounds and experience. These discussion groups can keep the user up to date on certain practices or give the opportunity to capture ideas from experts in a particular field.

- **Search Engines** - The Internet is so large that people do not know where to look for information. Networks around the world have vast quantities of files available for FTP but organization and indexing has been a problem. *Search engines* were created that locate networks to index and organize the files available. The engines allow for searches by keywords in the title or sometimes in the file itself. However, these searches have several drawbacks. Unless the keywords happen to be in the title, the search will not find the desired files. Also, the searches can take extraordinary amounts of time if the criteria is not specific enough.

- **Gophers** are simple text based information browsers. They do not support styled text or images. However, gophers have been in operation for a long time thus the most comprehensive sites on the Internet are gopher sites. They are precursors to the present WWW (see below).

- **World Wide Web** -The World Wide Web (WWW) is an advanced system for accessing documents containing styled text, images, and sound over the Internet (Engst, 1994). The most distinct feature of the WWW is its use of hypertext and hyperlinks. Some words in a document are marked, and each marked word has a link to another document or resource which may physically be located thousands of kilometres away at another computer. Yet, the user can smoothly move between these documents without concern about their physical location. The new document will also have links which will lead to another document. The term *surfing the Net* refers to following paths of links information through the WWW. The advent of the WWW makes it possible to provide easy access to a common pool of information. WWW documents contain information that includes photographic images from weather satellites, music, real time movies, or simple text files. The WWW allows a user to access the *home page* of a network which is the starting point to access other hypertext documents. By following different paths, desired information of all sorts may be found.

2 Internet facilities currently available at Mvula Trust

Currently, all members of staff at the Mvula trust have access to email facilities. However, full only one computer has full Internet capabilites which includes the ability to browse the World Wide Web (WWW). The trust receives her Internet servces from a commercial Intenet provider, Sangonet.

2.1. Internet, Water Supply and Environmental Sanitation

The use of Internet in dissemination of information on water supply and environmental sanitation is slowly growing. The publishers of the water bulletin *US Waternews* use the Internet to distribute electronic version of their technical publications. They also use it to make announcements of water related conferences and make available back copies of their magazine. Discussion forums on water related issues are also included.

The National Water Research Institute of Canada uses the Internet as a public relation tool to explain to the tax payers how their money is spent. Technical information from the institute including research findings is availed through the Internet.

The Asian Development Bank uses the Internet to explain to the various parties aspiring for bank funding on the standards and content of presentation expected in the motivation for such funding. A complete Environmental Impact Assessment report to be used as a guide in the bank funded projects is availed through the Internet. Such projects include those in water and environmental sanitation sector.

The World Bank/UNDP water and sanitation programme has a presence on the WWW. Various technical and policy publications coming out of the programme can be accessed through the WWW.

Interwater (formerly WENDY) is a local intiative to help in technology transfer amongst the developing countries in the water and sanitation sector. The project seek to link the experiences of various water and sanitation role players in developing coutries using the Internet. The trust can immensely gain from the initiative by using it as a media of information dissemination and gathering as well.

2.2. Why the WWW site for the Mvula trust?

The trust has identified project financial and technical support as one of its two specific objectives. The trust can use the proposed WWW site to explain to the various donor organisations the nature of various projects that the Trust is supporting. This can be used to supplement the various other mechanisms the trusts uses for raising funds to support these projects. On the other hand the trust can foster goodwill on the net by availing expertise in the areas in which we are strong for example in policy formulation. By fostering such goodwill other sector players will be encouraged to avail the information they have which may be of use to our various projects.

Identification and promotion of sustainable approaches in provision of water and sanitaition services is the other of the specific objectives of the trust. In the fulfilment of this objective, a WWW site can

play a supplementally role in the dissemination of the information on proven approaches in this regard.

3 Conclusion

Whereas the various mechanisms used by the trust in is dissemination and gathering of information will continue to play an important role in the foreseable future, the Internet provides a cheap and convinient (paperless) means of supplementing these efforts. It is thus recommended that the trustees sanction funds for use in this regard.

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Appendix 1

Motivation for the Mvula Trust to set up a WWW home page on the Internet

A need for Mvula trust to set up a home page on the Internet arises as a natural consequence of growth in the magnitude of the operations of the trust. By establishing a presence on the Internet, the trust stands to further its objectives in various ways.

1 Background to the Internet

The Internet has come into vogue in the last four years. It is also increasing rapidly in size. In 1992, there were 10 000 computer networks that made up the Internet. By August 1995, the figure was estimated at around 30 000 and predicted to reach 100 000 in the year 2 000 (Wilson, 1995). One of the main reasons for the speed at which the Internet is growing is the ease of connection. In countries with Internet connectivity, entrepreneurs saw a business opportunity and established their own computer networks known as *local providers*.

1.1. Definition

The Internet is a worldwide network of computers and computer networks which transmit data in digital form over normal telephone lines. Using the Internet costs about as much as a local telephone call and a subscription cost to the local Internet provider. These charges vary from country to country. In developing countries telecommunication and Internet services tend to be expensive but in developed countries same services are cheap a reason being the higher number of subscribers in developed countries lowering the break-even price. The Internet is a decentralised network. No single organisation operates or owns it. It is essentially a network of networks governed only by a set of protocols which specify how messages must be formatted or routed. This task is accomplished by the Internet Architecture Board (IAB) (Smith, 1994).

Although the Internet is very extensive, it is not the only channel of electronic communication available. There are other international networks and electronic channels that work independently of the Internet. However, the Internet is the biggest of the networks

1.2. History of the Internet

The Internet began in 1960 with the United States Department of Defence. The Advanced Research Projects Agency (ARPA) developed the first network of computers called appropriately ARPAnet. It was largely developed to support the space programme and its race with the Soviet Union. The USA government continued to experiment with this network for several years. Around 1980, two networks were developed at universities called Usenet and BITNET. These networks linked hundreds of computers but had nonstandard designs that restricted their growth to the general population (Wilson, 1995).

In 1986, the National Science Foundation (NSF) linked five supercomputer sites across USA to promote research work. With only five sites available, researchers would have to travel each time they needed access to the supercomputers. The NSF decided to create their own network, NSFNET, using regional

networks that connected schools and research sites in the same area (Engst, 1994). The NSFNET was the springboard for the addition of networks that currently comprise the Internet (Wilson, 1995).

The USA is a leader in the development and use of the Internet and is playing an active role in planning the future of the Internet. Some US $ 1 150 million were allocated in 1991 over five years to develop the National Research and Education Network (NREN). This *information superhighway* will provide a highspeed network needed until the twenty first century (Smith, 1994).

1.3. Internet applications

The Internet has several applications. Wilson (1995) summarises the major applications of the Internet below:-

- **Electronic Mail (e-mail)**- E-mail was one of the original applications created for networks. Very simply, it is the direct transfer of typed messages to any person with access to the Internet. E-mail allows almost instantaneous delivery of messages across the world. A further advantage of e-mail is that one can retrieve and reply to messages at leisure. Use of e-mail (and most of the other Internet based resources) has an environmental implication in that the amount of paper needed for information transfer is reduced. Different e-mail systems have various useful functions. Some systems have a *talk* feature allowing users to instantaneously see what the other person is writing and respond. Other systems can attach data or image files to the message. *See-you-see-me* feature of the E-mail enables instantaneous audio-visual communication between two persons. *Internet Relay Chat (IRC)* enables more than three people to hold an *electronic conference* where all the participants can view what each one of them is typing into the computer.
- **File Transfer Protocol (FTP)** is one of the most useful applications in the future of the Internet. FTP is used to transfer files or programs from one computer to another relatively quickly. This application is particularly useful because it allows the transfer of files across machine and language barriers. Each network around the world usually has a list of files or programs available to the public. Using FTP, the user can copy any file to their computer or send files to a remote computer. Examples of the files that can be copied using FTP include executable programs, data files, or even image files.
- **Telnet** is a simple application used exclusively for logging on to remote networks Telnet allows connection to any network around the world, however, each network usually has a security password that only permits guests limited access to its resources.
- **Usenet Newsgroups** - are round tables of dialogue being discussed on over 11,000 topics. The exchanges of information, called strings, start with a *posting* being made and the multiple responses to it. Most discussions are completely interactive. Some newsgroups are not interactive, however, and only provide periodic updates to the related topic. Since there are over

11,000 newsgroups in existence, most users subscribe to only a few. As the need or desire arises, new groups are created almost daily.

- **Discussion Groups** are often referred to as listservers or mailing lists. Discussion groups are written exchanges using e-mail which are either moderated or unmoderated. A list owner will invite people to join their list and any messages that are sent to the list will be copied to all subscribers across the world. This application allows for open discussions on many topics with people of varying backgrounds and experience. These discussion groups can keep the user up to date on certain practices or give the opportunity to capture ideas from experts in a particular field.

- **Search Engines** - The Internet is so large that people do not know where to look for information. Networks around the world have vast quantities of files available for FTP but organization and indexing has been a problem. *Search engines* were created that locate networks to index and organize the files available. The engines allow for searches by keywords in the title or sometimes in the file itself. However, these searches have several drawbacks. Unless the keywords happen to be in the title, the search will not find the desired files. Also, the searches can take extraordinary amounts of time if the criteria is not specific enough.

- **Gophers** are simple text based information browsers. They do not support styled text or images. However, gophers have been in operation for a long time thus the most comprehensive sites on the Internet are gopher sites. They are precursors to the present WWW (see below).

- **World Wide Web** -The World Wide Web (WWW) is an advanced system for accessing documents containing styled text, images, and sound over the Internet (Engst, 1994). The most distinct feature of the WWW is its use of hypertext and hyperlinks. Some words in a document are marked, and each marked word has a link to another document or resource which may physically be located thousands of kilometres away at another computer. Yet, the user can smoothly move between these documents without concern about their physical location. The new document will also have links which will lead to another document. The term *surfing the Net* refers to following paths of links information through the WWW. The advent of the WWW makes it possible to provide easy access to a common pool of information. WWW documents contain information that includes photographic images from weather satellites, music, real time movies, or simple text files. The WWW allows a user to access the *home page* of a network which is the starting point to access other hypertext documents. By following different paths, desired information of all sorts may be found.

2 Internet facilities currently available at Mvula Trust

Currently, all members of staff at the Mvula trust have access to email facilities. However, full only one computer has full Internet capabilites which includes the ability to browse the World Wide Web (WWW). The trust receives her Internet servces from a commercial Intenet provider, Sangonet.

2.1. Internet, Water Supply and Environmental Sanitation

The use of Internet in dissemination of information on water supply and environmental sanitation is slowly growing. The publishers of the water bulletin *US Waternews* use the Internet to distribute electronic version of their technical publications. They also use it to make announcements of water related conferences and make available back copies of their magazine. Discussion forums on water related issues are also included.

The National Water Research Institute of Canada uses the Internet as a public relation tool to explain to the tax payers how their money is spent. Technical information from the institute including research findings is availed through the Internet.

The Asian Development Bank uses the Internet to explain to the various parties aspiring for bank funding on the standards and content of presentation expected in the motivation for such funding. A complete Environmental Impact Assessment report to be used as a guide in the bank funded projects is availed through the Internet. Such projects include those in water and environmental sanitation sector.

The World Bank/UNDP water and sanitation programme has a presence on the WWW. Various technical and policy publications coming out of the programme can be accessed through the WWW.

Interwater (formerly WENDY) is a local intiative to help in technology transfer amongst the developing countries in the water and sanitation sector. The project seek to link the experiences of various water and sanitation role players in developing coutries using the Internet. The trust can immensely gain from the initiative by using it as a media of information dissemination and gathering as well.

2.2. Why the WWW site for the Mvula trust?

The trust has identified project financial and technical support as one of its two specific objectives. The trust can use the proposed WWW site to explain to the various donor organisations the nature of various projects that the Trust is supporting. This can be used to supplement the various other mechanisms the trusts uses for raising funds to support these projects. On the other hand the trust can foster goodwill on the net by availing expertise in the areas in which we are strong for example in policy formulation. By fostering such goodwill other sector players will be encouraged to avail the information they have which may be of use to our various projects.

Identification and promotion of sustainable approaches in provision of water and sanitaition services is the other of the specific objectives of the trust. In the fulfilment of this objective, a WWW site can

play a supplementally role in the dissemination of the information on proven approaches in this regard.

3 Conclusion

Whereas the various mechanisms used by the trust in is dissemination and gathering of information will continue to play an important role in the foreseable future, the Internet provides a cheap and convinient (paperless) means of supplementing these efforts. It is thus recommended that the trustees sanction funds for use in this regard.

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Appendix 2

INTERWATER

..... A Gateway to Water and Sanitation Information on the Internet

Buckley C.A.B.[1] and Kibata N.[2]

Introduction

Recent developments in electronic networking through the Internet open up new possibilities for the exchange of information between institutions and professionals in the water and sanitation sector. However, information on water and sanitation on the Internet is still scattered and hard to find. In an attempt to help find a solution to this problem, the International Association on Water Quality (IAWQ) and the Water Research Commission of South Africa agreed in 1995 to support the Pollution Research Group (PRG) at the University of Natal, Durban in creating an *information gateway*, in the form of a home page on the Internet, to be provisionally known as the Water Supply and Environmental Sanitation Services Electronic Network for Developing Country Needs (WENDY).

The IRC International Water and Sanitation Centre, together with the United Nations Centre for Human Settlements (Habitat), the Environmental Health Project (EHP) of USAID, and the Water, Engineering and Development Centre (WEDC) at Loughborough University were invited to become members of an International Steering Committee to guide this development. Following a demonstration of a prototype information gateway for the sector at the Third Global Forum of the Water Supply and Sanitation Collaborative Council, held in Barbados in November 1995, the Council approved the inclusion of the Internet initiative in its programme of activities for 1996-97, and authorised the Steering Committee to function as a Council Task Force on the subject, under the co-ordination of IRC.

Following discussion among Task Force members, it was decided to change the name of the initiative to INTERWATER in order to establish more clearly its connection with the water sector for users of the Internet.

Goals and Objectives

The overall goal of INTERWATER is to contribute to the more effective delivery of services in the water supply and sanitation sector in developing countries through improved information provision. This is in accordance with the aims and objectives of the Water Supply and Sanitation Collaborative Council, which are

... to enhance collaboration among developing countries and external support agencies so as to accelerate the achievement of sustainable water, sanitation and waste management services to all people, with special attention to the poor ...

While the general objective of INTERWATER is to promote and facilitate the exchange of data, information, knowledge and experience among water and sanitation institutions and professionals, its general objectives are to promote and facilitate, through the medium of the Internet:

- awareness of and access to sources of information,
- the generation and dissemination of information, and
- the establishment of effective networking among sector institutions and professionals.

The Internet

The Internet is a world-wide network of computers and computer networks which transmit data in digital form over telephone lines. It is essentially a decentralised network. i.e no one owns it (Buckley and Hurt, 1996).

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Intenet usage

Since 1990 there has been an exponential growth in use of the Internet. It is predicted that by the year 2000 the Internet will :

- have more than 100 million connected hosts,
- have more than 1 million connected networks,
- be available world wide, and
- reshape institutional, business, financial and political boundaries (Smith, 1994).

What information is available over the Internet?

The Internet has appropriately been described as a reservoir of information. Unfortunately, the information tends to be disjointed and even incomprehensible (Buckley *et al.*, 1996). However, useful information from institutions and individuals has been made available through the Internet. Potential users of this information must know of its availability and how to obtain it in order to make use of this information. Following is a listing of the information (Taylor, 1995) available on the Internet:

- newsletters,
- catalogues of publications,
- publication lists on specific topics,
- lists of training materials,
- information on training programmes,
- information on forthcoming events,
- bibliographic databases,
- factual databanks,

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- complete texts of conference papers,
- general information on the institution, and
- links to other information sources on the Web.

Practical applications of the Internet to problems encountered by water engineers and scientists are presented in form of anecdotes in **Appendix 2** (Buckley and Hurt, 1996).

The Internet, water and sanitation sector

The use of Internet in dissemination of information on water and sanitation sector is growing (Buckley *et al*., 1996). The publishers of the water bulletin *US Waternews* use the Internet to distribute electronic version of their technical publications. They also use it to make announcements of water related conferences and make available back copies of their magazine. Discussion forums on water related issues are also included. The National Water Research Institute of Canada uses the Internet as a public relation tool to explain to the tax payers how their money is spent. Technical information from the institute including research findings is availed through the Internet. The Asian Development Bank uses the Internet to explain to the various parties aspiring for bank funding on the standards and content of presentation expected in the motivation for such funding. A complete Environmental Impact Assessment report to be used as a guide in the bank funded projects is availed through the Internet. Such projects include those in water and environmental sanitation sector. The World Bank / UNDP water and sanitation programme has a presence on the WWW. Various technical and policy publications coming out of the programme can be accessed through the WWW.

Introduction of the INTERWATER prototype site on Internet gave rise to inclusion of some technical information on water and sanitation in developing countries on the Internet. A sample of information available through INTERWATER is provided in **Appendix 1**. It should also be noted that the main INTERWATER prototype page is avilable through the URL

http://www.ccwr.ac.za/wendy/

Why INTERWATER?

INTERWATER is a collaborative electronic network of partner institutions in the water and sanitation sector, operating under the auspices of the Water Supply and Sanitation Collaborative Council. It acts as a gateway to sources of water and sanitation information which are accessible through the Internet. This is to be achieved through a number of key activities i.e.

- establishing an INTERWATER home page on the Internet which will point the way to information provided by partner institutions in the network, and to the activities of the Water Supply and Sanitation Collaborative Council and to sources of information, activities and contacts outside the INTERWATER partner institutions,
- operating and maintaining the network through the provision of protocols, guidelines, standards and manuals,
- maintaining up-to-date links with other sources of information,
- promoting the use of information by increasing awareness of INTERWATER and through capacity building in the use of the network, and
- promoting the expansion of INTERWATER by increasing the number of partner institutions and improving physical access to the network through the promotion of pilot projects.

Scope and Functions

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Scope and Functions

In accordance with its overall goal, INTERWATER is concerned primarily with water supply and environmental sanitation in developing countries. It aims to guide users to sources of information, professional contacts, etc., which are of potential relevance and value to those involved with this field, rather than itself providing substantive information on these subjects. Responsibility for providing substantive information to INTERWATER users rests mainly with the partner institutions, through the medium of their own home pages.

The principal functions of INTERWATER are:

- to provide an up-to-date, structured and user-friendly guide or pointer to sources of information on water supply and sanitation available both from partner institutions and from other sources which are accessible through the Internet,
- to provide an effective mechanism for the dissemination of information by sector institutions,
- to provide an effective channel of electronic communication between sector institutions and professionals in all parts of the world, and
- to promote and propose pilot projects designed to provide selected institutions in developing countries with the equipment, materials, training, etc., required to help them to provide and obtain information through INTERWATER (and other channels).

Additional functions are:

- to develop and distribute protocols, guidelines, standards and manuals defining the rules, procedures and methods of operation of INTERWATER,
- to promote the use of INTERWATER through awareness raising, capacity building and training activities, and
- to promote the expansion of INTERWATER by encouraging and assisting sector institutions to become partners.

Organisation and Membership

INTERWATER will operate under the auspices of the Water Supply and Sanitation Collaborative Council as a collaborative network of equal partner institutions guided by an International Steering Committee on which each partner will be represented. The Steering Committee will constitute a Task Force of the Collaborative Council for as long as the Council continues to extend its mandate to the INTERWATER activity. The Committee will formulate its own rules of procedure and those for the operation and management of the network as a whole.

Any institution wishing to become a partner in INTERWATER must:

- accept and agree to support the goals and objectives of INTERWATER,
- maintain its own home page on the Internet and agree to link this page to INTERWATER,
- be willing and able to participate in the INTERWATER International Steering Committee/Task Force, and
- agree to abide by the protocols, guidelines, standards and manuals defining the rules, procedures and methods of operation of INTERWATER.

Resource Requirements

In accordance with its overall goal, INTERWATER is concerned primarily with water supply and environmental sanitation in developing countries. It aims to guide users to sources of information, professional contacts, etc., which are of potential relevance and value to those involved with this field, rather than itself providing substantive information on these subjects. Responsibility for providing substantive information to INTERWATER users rests mainly with the partner institutions, through the medium of their own home pages.

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Resource Requirements

In accordance with procedures laid down by the Collaborative Council, it is the responsibility of the Coordinator, with the support of other Task Force members, to provide the resources required to implement INTERWATER and, if necessary, to mobilise any additional resources as needed.

In order for the INTERWATER initiative to be sustainable in the long term, however, it may be necessary:

- to allow individual partners to charge for information and services provided through their own home pages, and
- to charge a subscription or membership fee to partners to cover the services of the central maintenance team and the work of the International Steering Committee.

Conclusion

INTERWATER provides an opportunity for dissemination of information on water and sanitation in developing countries over the Internet. On the other hand, it is necessary for institutions that hold information relevant to the sector to avail it over the Internet. In this way, INTERWATER's overall goal of contributing to a more effective delivery of services in the water and sanitation sector of developing countries would be realised.

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In accordance with procedures laid down by the Collaborative Council, it is the responsibility of the Coordinator, with the support of other Task Force members, to provide the resources required to implement INTERWATER and, if necessary, to mobilise any additional resources as needed.

In order for the INTERWATER initiative to be sustainable in the long term, however, it may be necessary:

- to allow individual partners to charge for information and services provided through their own home pages, and
- to charge a subscription or membership fee to partners to cover the services of the central maintenance team and the work of the International Steering Committee.

Conclusion

INTERWATER provides an opportunity for dissemination of information on water and sanitation in developing countries over the Internet. On the other hand, it is necessary for institutions that hold information relevant to the sector to avail it over the Internet. In this way, INTERWATER's overall goal of contributing to a more effective delivery of services in the water and sanitation sector of developing countries would be realised.

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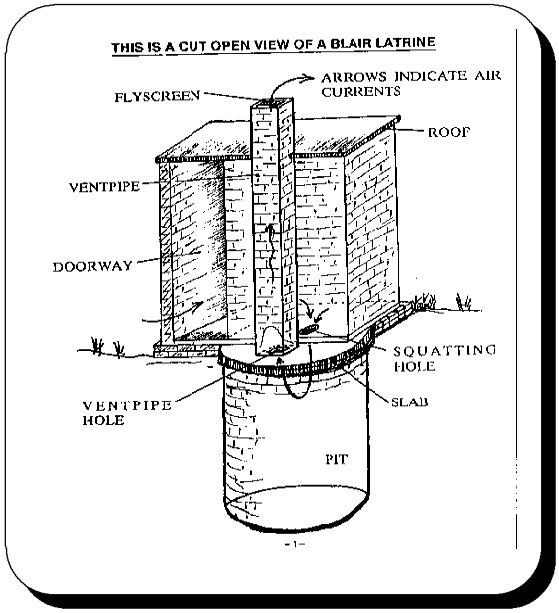
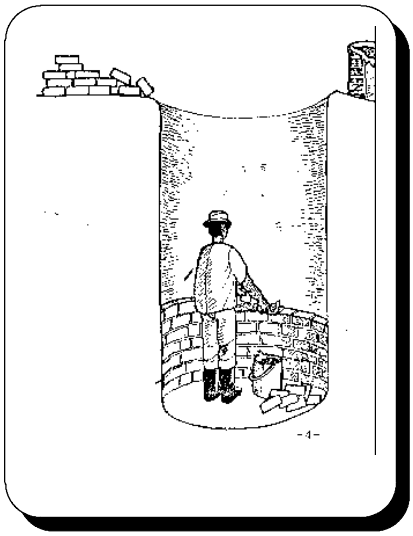
Acknowledgements

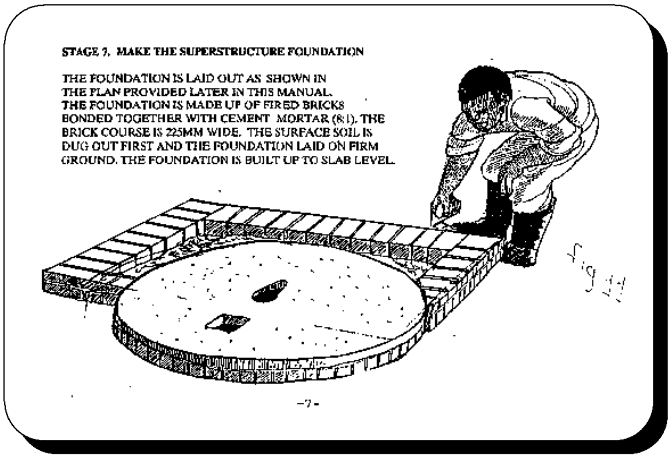
The International Association on Water Quality (IAWQ), London provided the seed money for setting up of the prototype WENDY web site. IAWQ also provided the funding for travel to present this paper. Input from various INTERWATER partner institutions especially the International Reference Centre for Water and Sanitation (IRC), The Hague and Water Research Commission of South Africa, Pretoria is also appreciated. The authors would also like to appreciate contributions by Mr. Q. E. Hurt of Ecoserv (Pty) Ltd in the anecdotes provided in **Appendix 2**.



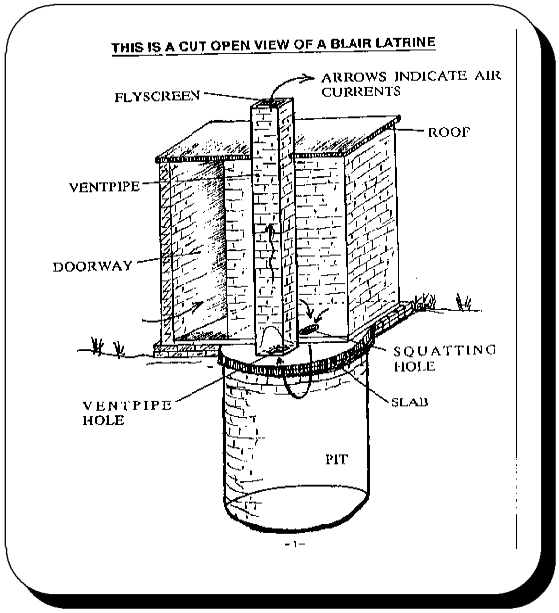


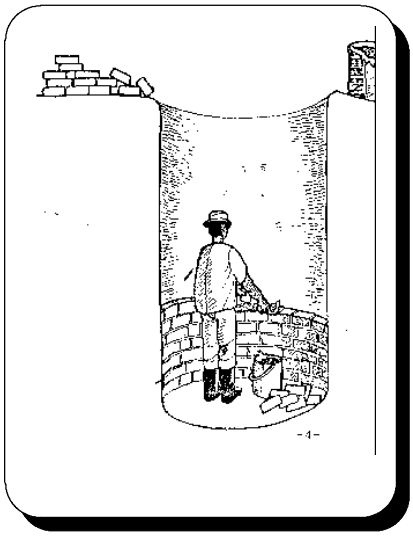
Appendix 1

Sample information from the INTERWATER WWW page



Various pages within INTEWATER contain information from different institutions. From Mvuramazi Trust, Various designs for ventilated improved pit latrines (VIPLs) can be viewed or even be printed out from the Mvuramanzi Trust page on INTERWATER at **http://www.ccwr.ac.za/wendy/man3.html**. The Mvuramanzi trust is an indigenous, non governmental, non profit making organisation. The trust, was established with the aims and objectives of assisting Government, NGOs and other organisations in implementing projects in





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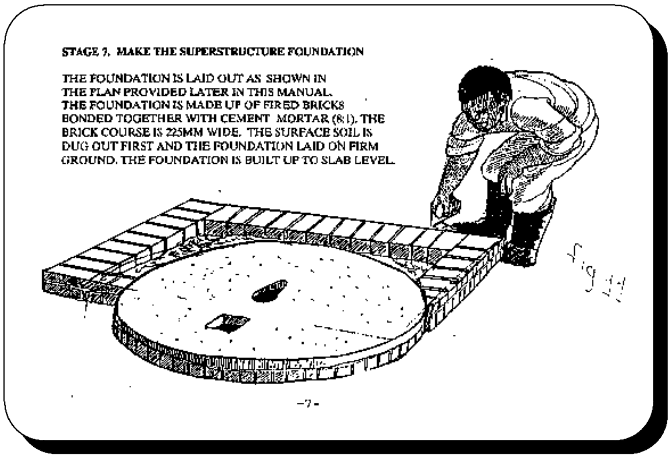

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the area of appropriate drinking water supplies and sanitation in the rural and peri-urban areas of Zimbabwe; to act as a resource centre for the dissemination of information, knowledge and experience in water supplies and sanitation, and related areas of health education; and to undertake applied research and development into appropriate technologies.

As a result of The Mvuramanzi Trust's research programme, various designs of VIPLS corresponding to different quantities of cement required in construction, and hence costs have been undertaken. The cross-sectional view of the VIPL in the frame was downloaded from the Mvuramanzi Trust home page with the URL **http://www.ccwr.ac.za/interwater/2bagfig1.jpg**. information of such kind would be useful to a field practioner. Also available through INTERWATER pages are various builders manuals for these varying designs of the VIPLs. The page has included a detailed construction manual which explains the steps neccesary in the construction of VIPLs. The drawing on the right is an extract from the manual available online from the Mvuramanzi Trust page accessed via INTERWATER at **htttp://www.ccwr.ac.za/interwater/2bag.html**. This is stage number 2 (lining the pit) in construction of a 2 bag model of a VIPL. In all the cases, 2 bag refers to the number of 50 kg pockets of cement used in construction the VIPL. The same applies to 3 bag, 4 bag, 5 bag, etc. models. The other stages in this construction as explained in the manual, are siting the toilet, digging the pit, finishing the lining, making the cover slab mould, making the cover slab, placing the cover slab, and making the cover slab foundation. The drawing below is a sample taken from the page illustrating this latter step; this being the 7th step. In this illustration, the manual recommends the use of cement mortar (8:1) in bonding fired clay bricks. The manual also suggests a 225 mm wide brick course. The other steps in the manual are building of the superstructure and ventilation pipe, making latrine floor, fitting the fly screen, adding thatched roof and finishing off.

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Appendix 2

Why Scientists and Engineers need the Internet - Anecdotes by Q. Hurt[3] and C. A. Buckley

The following is a listing of various internet applications that are available:

- e-mail
- list servers
- news groups
- File Transfer Protocol (FTP)
- Gopher
- World Wide Web (WWW)
- Internet phone
- Internet video conference

A descriptive anecdote of each application then follows.

E-mail

Email allows communication between users on different computers or networks

- the messages ate in electronic form - no retyping
- text and files
- rapid and inexpensive

Problem : Fritz, an engineer on a remote construction site has a technical problem and seeks advice from his colleagues in head office or any of the regional offices.

Action : He writes a report on his PC, connects it to the telephone line with a modem, dials the local node of his Internet provider and transmits an e-mail message. The call may last 10 min. Included with the report are the associated spreadsheet files so calculations can be checked. If the site engineer has a video camera and video grabbing card, then annotated colour pictures of the site can also be transmitted. All the offices receive the message within minutes. Fritz then leaves the site office and goes back on site.

The calculations can be checked, the photographs examined and possible solutions sketched on them, individual experts then send their replies, by e-mail, to Fritz.

When the site work has been completed Fritz dials into his Internet service provider and downloads his e-mail containing comments from his colleagues.

List servers

List servers allow regular communication between a predefined group (list) by e-mail. An e-mail message is sent to a central hub (the listserver) and it is automatically retransmitted to all the members of the service.

[3] **Ecoserv (PTY) Ltd., P. O. Box 37945, Overport, 4067, South Africa.**z

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Problem : Kate, a scientist in a water laboratory is having difficulty in developing an analytical proceedure for the sequential stripping of heavy metals from an anaerobic digester sludge.

Action : She is a member of the **environmental engineering** listserver so she writes a one page description of her problem and sends it as an e-mail message to the listserver. It is then automatically retransmitted all over the world to the members of the group. The next time a member logs into their Internet provider they will receive Kate's e-mail message with the request. Any member of the group can then add their comments to the original message or compile a new message detailing procedures, references and general experience on the topic. These messages are then downloaded to the listserver and broadcast to all the members. Any one is then free to send a general message to the listserver or can contact Kate directly. If the topic is of sufficient interest a discussion can continue for several weeks or months. Kate has now many leads to assist her in solving her problem.

News groups

News groups are global electronic billboard where messages and answers can be posted. They are very simple to use.

Problem : Praveen is the environmental manager at a progressive water authority, he needs to well informed about environmental trends in other parts of the world. He subscribes to a number of journals but they usually arrive three months late.

Action : Praveen adds all the environmental news groups to the profile in his newsreader on his PC. Every Friday afternoon Praveen logs into his Internet provider and downloads the latest entries in all the environmental news groups. This takes about 10 min. He then logs out and reads the entries at his leisure. As many of the entries are obviously not of technical interest he sets his filter in his newsreader to filter out all unwanted mail. He then spends 15 minutes reading his **news**. He can follow up any item by replying to the originator of the article or he can post his own message to the **news** service.

The World Wide Web

- currently the ultimate in computer communication,
- browsers such as Netscape or Mosaic give non-technical users access to pages of information intuitively linked to other pages of information
- formatted text, graphics, colour pictures, real time movies, live sound, and
- extensive search tools.

Problem : Sipho wishes to understand the speciation chemistry of an acid minewater effluent. He has read the chemistry textbooks but realises he needs some practical guidance and some usable tools.

Action : Sipho realises that the web is slow during the middle of the day so he comes to work early on a Monday morning. He logs onto the Internet and loads his web browser. He starts off by pressing *net search* and selects Alta Vista, one of the web search engines. On entering **chemical speciation** as a key word Sipho finds that these key words occurred in 5 000 different locations on the web, they are presented in batches of 10. Some of the entries relate to computer programs that can be downloaded for free, others to new books, journal articles and current research projects. Many of these links lead on to further information. By the time the rest of the office arrives at work, Sipho is as well informed on sources of information on the topic as anyone in the country. He can download information directly, request specific information by e-mailing the researchers directly and visit his technical library or local university to request journal articles or books using Interlibrary Loan. By lunch time he can start cutting and pasting the information into a progress report which he completes before going home that evening.

File Transfer Protocol

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File Transfer Protocol

FTP allows an Internet user to log onto computers all around the world and download information.

Problem : Susan has just changed jobs, in her previous job she frequently used health and safety data sheets supplied by the US EPA. These were not available at her new company and she urgently required them

Action : Susan logs onto the Internet and logs onto an EPA computer in the States. She searches the archives untill she finds the required file and downloads it to her work computer. Since it is in *zipped* format she logs onto a South African university FTP site and downloads a freeware program that she can add to her Windows file manager to automatically zip and unzip files.

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APPENDIX 3

SOUTH AFRICAN INSTITUTION OF CIVIL ENGINEERING

Community Empowerment Through Technology

Nineteenth Annual Symposium on Computers in Engineering

Water and Sanitation in Developing Countries: Internet Based Information Provision.

Ndirangu Kibata
Pollution Research Centre
Department of Civil Engineering
University of Durban-Westville
P/Bag X54001 Durban 4000

Synopsis

Technology and experiential exchange among sector professionals in developing countries in the field of water and sanitation has been suggested as one of the ways in which costs related to the provision of these services could be reduced. Such an exchange would also have the advantage of ensuring that suitable technology and experience that has been tested under similar conditions is used without the accompanying research and development costs and delay in implementation.

The Internet is one possible medium through which the proposed exchange could be undertaken. In addition, other complementary functions such as information dissemination and sector advocacy could also be carried out through this medium. The Internet has the advantages of low costs, high speed of transmission and ability to operate in areas with poor communication infrastructure.

In order to test the suitability of using the Internet for these purposes, a prototype information provider based on the Internet was established. This provider was designed to assist the user solve a range of problems encountered in provision of water and sanitation services in developing countries. It was used to evaluate the potential usefulness of the such providers in meeting the objectives of facilitating an efficient delivery of services in water and sanitation sectors of developing countries.

Initial results indicate that the information provider has the potential to assist the user in solution of various institutional and technical challenges facing them in developing countries. These conclusions can be extended to cover other Internet based initiatives for providing water and sanitation services in developing communities.

1 GENERAL

Water supply and environmental sanitation in developing countries is limited by scarcity of resources, both fiscal and institutional. This shortfall in developing countries in resources has often compromised the sector's ability to deliver the benefits of clean water supply and enhanced environmental sanitation[1]. It is thus necessary to study means by which benefits of improved water supply and environmental sanitation can be delivered taking cognisance of technological advances in areas of information technology.

1.1. Water Supply and Environmental Sanitation in Developing Countries: Overview

It is estimated that in 1994, 21 million South Africans did not have access to adequate sanitation facilities. Of this figure, 7.67 million (31 %) were in urban areas. The rest were in rural areas which represented about 85 % of the rural population[2]. Further, 17.45 million people did not have access to piped water. Although piped water is not the only means of adequate water supply, the percentage population with access to other adequate forms of water supply is insignificant[3]. The need to arrest and redress the situation arises. South Africa, being a microcosm of the developing countries, faces challenges experienced by other developing countries in the supply of clean water and adequate sanitation.

Investing in water supply and environmental sanitation is considered beneficial to a country's populace. Definite correlation between improved environmental sanitation and water supply on one hand and decrease in infant mortality has been found. Other studies suggest reduced morbidity from a host of water borne diseases with improved water supply and environmental sanitation[4]. Improper sanitation leads to excreta disposal that lacks privacy with attendant loss of human dignity[5].

Due to almost similar conditions prevailing in developing countries, information and experiential exchange in the sector of water and environmental sanitation has been suggested as a way of reducing costs of delivering services while at the same time ensuring reasonable standards are maintained. For various reasons e.g. ignorance of the existence of information among developing countries, this has not always been possible. In most cases, water supply and environmental sanitation programmes are funded from the West and the Pacific Rim. The practice has been to transfer technology from the developed to the developing countries. Often, the technology so transferred has been unrealistically expensive and at times unsuitable.

One possible network is an information provider based on the Internet. This would have the advantage of portability, low transmission cost and a large and expanding coverage. The information provider so created would have the potential of assisting users in formulating solutions for a number of water and environmental sanitation problems. This would be done by publicising technological and other related information that may be available among the developing countries.

1.2. Internet in Engineering

Increased use of the Internet in developed countries is changing engineering practices in those countries. Using tools available on the Internet, engineers are being able to access data at a higher speed than has hitherto been the case. It has also become possible to pose technical questions to other engineers who have access to the Internet. Electronic mail (e-mail) has enabled a fast and efficient system of information transfer between the various branch offices of an engineering organisation. It has become, say to have an engineering team on site doing the field work and another one in the head office doing the design simultaneously. This would have an effect of saving costs and time[6].

1.2.1 Definition

The Internet is a world-wide network of computers and computer networks which transmit data in digital form over normal telephone lines and/or data cables. The charges vary from country to country. In developing countries, telecommunication and Internet services tend to be expensive but in developed countries the same services are inexpensive a reason being the higher number of subscribers in developed countries lowering the break-even price. The Internet is a decentralised network. No single organisation operates or owns it. It is essentially a network of networks governed only by a set of protocols which specify how information must be formatted or routed. This task is accomplished by the Internet Architecture Board (IAB)[7].

Although the Internet is very extensive, it is not the only channel of electronic communication available. There are other international networks and electronic channels that work independently of the Internet. However, the Internet is the biggest of the networks[8]. The development of the Internet has also lead to a growth of parallel networks referred to as *Intranets*. The *Intranets* are similar in operations to the Internet but their access is limited e.g.. to individuals within an organisation.

1.2.2 History of the Internet

The Internet began in 1960 with the United States Department of Defence. The Advanced Research Projects Agency (ARPA) developed the first network of computers appropriately called ARPAnet. It was largely developed to support the space programme and its race with the Soviet Union. The U.S.A government continued to experiment with this network for several years. Around 1980, two networks were developed at universities called Usenet and BITNET. These networks linked hundreds of computers but had non-standard designs that restricted their growth to the general population[9].

In 1986, the National Science Foundation (NSF) linked five super computer sites across U.S.A to promote research work. With only five sites available, researchers would have to travel each time they needed access to the super computers. The NSF decided to create their own network, NSFNET, using regional networks that connected schools and research sites in the same area (Engst, 1994). The NSFNET was the springboard for the addition of networks that currently comprise the Internet (Wilson, 1995).

The USA is a leader in the development and use of the Internet and is playing an active role in planning the future of the Internet. Some US $ 1 150 million were allocated in 1991 over five years to develop the National Research and Education Network (NREN). This *information superhighway* will provide a high speed network needed until the twenty first century (Smith, 1994).

1.2.3 Internet, Water Supply and Environmental Sanitation

The use of Internet in dissemination of information on water supply and environmental sanitation is not new. The publishers of the water bulletin *US Waternews* use the Internet to distribute electronic version of their technical publications. They also use it to make announcements of water related conferences and make available back copies of their magazine. Discussion forums on water related issues are also included.

The National Water Research Institute of Canada uses the Internet as a public relation tool to explain to the tax payers how their money is spent. Technical information from the institute including research findings is accessed through the Internet.

The Asian Development Bank uses the Internet to explain to the various parties aspiring for bank funding on the standards and content of presentation expected in the motivation for such funding. A complete Environmental Impact Assessment report to be used as a guide in the bank funded projects is availed through the Internet. Such projects include those in water and environmental sanitation sector.

Appendix 1 gives a list of addresses on the Internet of various water and environmental sanitation resources. Location address on the Internet is referred to as a URL (uniform resource locator).

1.3. WENDY and INTERWATER Projects.

Information on water and sanitation on the Internet is scattered and hard to find. In an attempt to help find a solution to this problem, the International Association on Water Quality (IAWQ) and the Water Research Commission of South Africa agreed in 1995 to support the Pollution Research Group (PRG) at the University of Natal, Durban in creating an *information gateway*, in the form of a home page on the Internet, to be provisionally known as the Water Supply and Environmental Sanitation Services Electronic Network for Developing Country Needs (WENDY).

The IRC International Water and Sanitation Centre, together with the United Nations Centre for Human Settlements (Habitat), the Environmental Health Project (EHP) of USAID, and the Water, Engineering and Development Centre (WEDC) at Loughborough University were invited to become members of an International Steering Committee to guide this development. Following a demonstration of a prototype information gateway for the sector at the Third Global Forum of the Water Supply and Sanitation Collaborative Council, held in Barbados in November 1995, the Council approved the inclusion of the Internet initiative in its programme of activities for 1996-97, and authorised the Steering Committee to function as a Council Task Force on the subject, under the co-ordination of IRC.

Following discussion among Task Force members, it was decided to change the name of the initiative to INTERWATER in order to establish more clearly its connection with the water sector for users of the Internet.

While the general objective of INTERWATER was to promote and facilitate the exchange of data, information, knowledge and experience among water and sanitation institutions and professionals in developing countries, its general objectives were to promote and facilitate, through the medium of the Internet:

- awareness of and access to sources of information,
- the generation and dissemination of information, and
- the establishment of effective networking among sector institutions and professionals.

These objectives were formulated with a view to improving on the delivery of services in the water and environmental sanitation sectors of developing countries.

This study fell under the aegis of the INTERWATER project.

1.4. Objectives of the Study

The objectives of the study were to :-

- to design a suitable format in which the information provider can be constructed on the Internet.
- to construct a prototype information provider on the Internet that will be used as a pilot test for the complete information provider.
- to identify through a partial literature search issues that are pertinent to the provision of clean water and adequate sanitation in developing countries. These are the issues that need data, information and to be generated and disseminated and views exchanged among the sector professionals as stated in the objectives of INTERWATER.

- w evaluate the potential effectiveness of the information provider in carrying out the objectives of INTERWATER.

2 THE WATER SUPPLY AND ENVIRONMENTAL SANITATION SECTORS OF DEVELOPING COUNTRIES AND THE EMERGENCE OF THE INTERNET: CHALLENGES AND OPPORTUNITIES.

Talero and Gaudette[11] believe that a new kind of economy, the information economy, is emerging. This new economy has global feature with trade and investment being conducted on a networked basis and with knowledge. A corresponding new society is emerging. Among other features of this society, it is more friendly to the environment. The emergence of this society has been reported by Stevens and Defenderfer(1996)[12] who describes an *Internet community* that has features of communities in the traditional sense of the word the only difference is the physical contact between members of the community. Talero and Gaudette (1996)[11] see a need brought about by these changes for developing countries to adjust in order to harness this emerging information revolution.

Ways in which the opportunity presented by the information revolution could be realised have been suggested by Talero and Gaudette (1996) as:

- w widespread and equitable access to communication and information services through accelerate deployment of national information infrastructure and effective integration into international communication and information network.
- w systematic improvements in functioning and competitiveness of key economic sectors through strategic information policies and systems,
- w new ways to use information technology to help solve the problems of human and economic development.

This paper argues that one way in which the developing countries can place themselves in a position to take advantage of the emerging information economy as argued in the last point above is to apply the information technology to the water supply and sanitation sectors of developing countries.

The role of communication in delivery of services in water supply and environmental sanitation sectors of developing countries is well documented elsewhere[5, 13, 14]. However, the opportunities presented by the emergence of the information economy as seen by Talero and Gaudette (1996)[11] have not explored in adequate details. This paper seeks to explore the means by which these emerging opportunities can be utilised in delivery of water and sanitation services.

2.1. Water Supply, Environmental Sanitation and the Internet in Developing Countries

The Internet as defined in earlier has come into vogue over the last five years. It is also increasing rapidly in size. In 1992, there were 10 000 networks that made up the Internet. By June 1997, the figure was estimated at around 60 000 and predicted to reach 100 000 in the year 2000[15]. One of the main reasons for the speed at which the Internet is growing is the ease of connection. In countries with Internet connectivity, entrepreneurs saw a business opportunity and established their own computer networks called *local providers*. Most cities in the USA now have local providers that charge a fee for unlimited access to the Internet. If there is no local provider available, long distance phone charges are the biggest cost element of Internet access.

2.2. Internet Applications

The Internet has several applications. Wilson (1995)[9], Buckley and Kibata (1996)[6] as well as Buckley and Hurt (1996)[15] summarise the major applications of the Internet:-

Electronic Mail (e-mail)- E-mail was one of the original applications created for networks. Very simply, it is the direct transfer of typed messages to any person with access to the Internet. E-mail allows almost instantaneous delivery of messages across the world. A further advantage of e-mail is that one can retrieve and reply to messages at leisure. Use of e-mail (and most of the other Internet based resources) has an environmental implication in that the amount of paper needed for information transfer is reduced. Different e-mail systems have various useful functions. Some systems have a *talk* feature allowing users to instantaneously see what the other person is writing and respond. Other systems can attach data or image files to the message. *See-you-see-me* feature of the E-mail enables instantaneous audio-visual communication between two persons. *Internet Relay Chat (IRC)* enables more than three people to hold an *electronic conference* where all the participants can view what each one of them is typing into the computer.

File Transfer Protocol (FTP) is one of the most useful applications in the future of the Internet. FTP is used to transfer files or programs from one computer to another relatively quickly. This application is particularly useful because it allows the transfer of files across machine and language barriers. Each network around the world usually has a list of files or programs available to the public. Using FTP, the user can copy any file to their computer or send files to a remote computer. Examples of the files that can be copied using FTP include executable programs, data files, or even image files.

Telnet is a simple application used exclusively for logging on to remote networks Telnet allows connection to any network around the world, however, each network usually has a security password that only permits guests limited access to its resources.

Usenet Newsgroups - are round tables of dialogue being discussed on over 11,000 topics. The exchanges of information, called strings, start with a *posting* being made and the multiple responses to it. Most discussions are completely interactive. Some newsgroups are not interactive, however, and only provide periodic updates to the related topic. Since there are over 11,000 newsgroups in existence, most users subscribe to only a few. As the need or desire arises, new groups are created almost daily.

Discussion Groups are often referred to as listservers or mailing lists. Discussion groups are written exchanges using e-mail which are either moderated or unmoderated. A list owner will invite people to join their list and any messages that are sent to the list will be copied to all subscribers across the world. This application allows for open discussions on many topics with people of varying backgrounds and experience. These discussion groups can keep the user up to date on certain practices or give the opportunity to capture ideas from experts in a particular field.

Search Engines - The Internet is so large that people do not know where to look for information. Networks around the world have vast quantities of files available for FTP but organisation and indexing has been a problem. *Search engines* were created that locate networks to index and organise the files available. The engines allow for searches by keywords in the title or sometimes in the file itself. However, these searches have several drawbacks. Unless the keywords happen to be in the title, the search will not find the desired files. Also, the searches can take extraordinary amounts of time if the criteria is not specific enough.

Gophers are simple text based information browsers. They do not support styled text or images. However, gophers have been in operation for a long time thus the most comprehensive sites on the Internet are gopher sites. They are precursors to the present WWW (see below).

World Wide Web -The World Wide Web (WWW) is an advanced system for accessing documents containing styled text, images, and sound over the Internet. The most distinct feature of the WWW is its use of hypertext and hyperlinks. Some words in a document are marked, and each marked word has a link to another document or resource which may physically be located thousands of kilometres away at another computer. Yet, the user can smoothly move between these documents without concern about their physical location. The new document will also have links which will lead to another document. The term *surfing the*

Net refers to following paths of links information through the WWW. The advent of the WWW makes it possible to provide easy access to a common pool of information. WWW documents contain information that includes photographic images from weather satellites, music, real time movies, or simple text files. The WWW allows a user to access the *home page* of a network which is the starting point to access other hypertext documents. By following different paths, desired information of all sorts may be found.

The prototype information provider used in evaluation was mainly but not exclusively based on the World Wide Web.

Austin (1995)[16] has identified three problems associated with the use of the Internet. The access of information on the Internet can be slow in some countries and more so if the hardware in use is outdated. Hardware in this case may include overloaded communication line. Computer viruses can easily be transmitted via the Internet. This happens when files are downloaded from the Internet. By far the most compelling problem on the Internet has been that related to security of information in the computer networks. Internet has made it easier for computer hackers to breach the security of computers that are connected on the Internet. A temporary measure being undertaken is to use *firewalling* computers to ensure information security. However, these measures are thought to be inadequate.

Austin (1995)[16] asserts that most Internet users are in developed countries. Reuters (1995)[17] reports the low number of Internet *host computers* in developing countries. **Table 1** shows the estimated number of Internet host computers in the world. Reuters (1995)[17] attributes the low level of Internet related activities in developing countries to low income and high level of illiteracy. High cost of computers is also to blame. This high cost is partly attributable to governments' high taxes on imports. Reuters warn that this lack of access to the Internet by developing countries could lead to a new form of poverty referred to as *information poverty*. This form of poverty is likely to deprive developing nations access to a large reservoir of information accessible through the Internet and necessary for the development of these countries.

Table 1: Number of host computers in different regions of the world as of June 1997 (ISOC, 1997)

Region/ Country	No. of host computers
USA	6 800 000
Western Europe	1 000 000
Asia and Pacific Rim	800 000
Africa	54 100
Middle East	26 800
Central & South America	16 000

In recognition of the dangers inherent in the developing countries' inability to link on to the Internet, the international community is in various ways attempting to help developing countries to link up. Parker (1995) reports of the initiative by a group of potential donors such as UNDP and USAID to channel about US $ 60 million to help improve Internet access in developing countries especially in Africa. International Development Research Council (IDRC) is currently undertaking a similar project in poor Asian countries under the Pan Asia Networking programme. A pilot project has been started in Mongolia.

3 CONSTRUCTION AND EVALUATION OF THE PROTOTYPE INFORMATION PROVIDER ON THE INTERNET

The proposed information provider was mostly but not exclusively to be based on the WWW. The provider was proposed to form a database that was a mixture of full text, data base and a referral system. However, all the information was to be held by different computer networks around the world. The WWW offered a form of electronic publishing in which all the networked information could be retrieved. The WWW offered the advantage of the fact that graphical representations and diagrams could be used. Other character styles associated with word processors such as bolding, italicising, etc. could also included on the provider.

In order to evaluate the usefulness of the proposed provider, a prototype information provider was constructed on the Internet containing a microcosm of the expected information on the full scale provider.

3.1. Data Collection

In order to construct the information provider, consideration had to be given to the type, quantity and quality of information necessary. The information specific to the needs of various end users was surveyed in assessing the type of information for inclusion in the proposed provider. This information was assumed to be found within the developing countries. The likely end users were identified to be consulting engineers, water authorities, municipal authorities, engineering contractors, government bodies, urban communities, non governmental organisations, researchers and research agencies, and aid organisations. Due to time limitations, only one kind of each identified end user was interviewed. The survey was done through e-mail, face-to-face and telephonic interviews. These perceived needs are summarised in **Appendix 2.**

Various options in data collection for use in the information provider were considered and briefly tested as follows:-

- A request was circulated in water and environmental listservers on the Internet. People / organisations with information on water supply and sanitation in developing countries were requested to volunteer the information. Information on the following areas was sought:-
    - research
    - case studies (successful and unsuccessful)
    - reports from funding agencies
    - sociological issues
    - evaluation of treatment processes
    - training resources
    - bulletins
    - equipment
    - aquatic environmental quality
    - water quality legislation

The results of this blanket call for information were mixed. Generally, members of the particular mailing lists (listservers) were willing to provide the information required. However, the information sources were not in electronic form. This information also tended to be scattered such that making links to each of the bit of information would make the proposed information provider unwieldy with many link to sources that do not contain extensive amounts of information.

- A search on the WWW was conducted using the five main search engines at the time namely *Alta Vista, Lycos, Infoseek, Webcrawler* and *WWW Worm.* None of the search engines yielded information that was considered to be of value to the water and sanitation sector in developing countries. Moreover, the search terms used such as water, sanitation, and developing countries yielded a large number of irrelevant sites and articles.
- Eight organisations with working experience in water and sanitation sector in developing countries were invited to form a collaborative partnership in which each of the organisation was to maintain its own WWW pages. All these pages were to be indexed from the proposed information provider. The organisations involved were The Water Supply and Sanitation Collaborative Council (WSSCC) based in Geneva, International Association on Water Quality (IAWQ), London, International Water and Sanitation Centre (IRC) from The Hague, Netherlands, United Nations Centre for Human Settlements (Habitat), US Agency for International Development (USAID) through its Environmental Health Program (EHP), The Water Research Commission (WRC) of South Africa and The Water and Engineering and Development Centre (WEDC), Loughborough, UK.

This approach seemed feasible and was the one that was eventually adopted for data collection. Between these organisations, a large amount of *grey literature* is available. For example, in its library, the International Reference Centre has over ten thousand documents mostly *grey literature* on water and sanitation in developing countries. Thus pooled together, the information held by these organisations could be used to form a nucleus around which the information provider would be created.

3.2. Construction of the Information Provider over the Internet.

In forming the basis for a decision tree, two approaches were adopted. Originally, it was assumed that the issues affecting the water and sanitation sector of developing countries could be divided into those of the rural areas and those peculiar to urban areas. This was labelled as the binary approach. Eventually, this approach was dropped in favour of an approach that assumed equal applicability of issues in both urban and rural areas. This labelled as the Multifaceted approach. **Figure 1** illustrates the logic flow in the multifaceted approach.

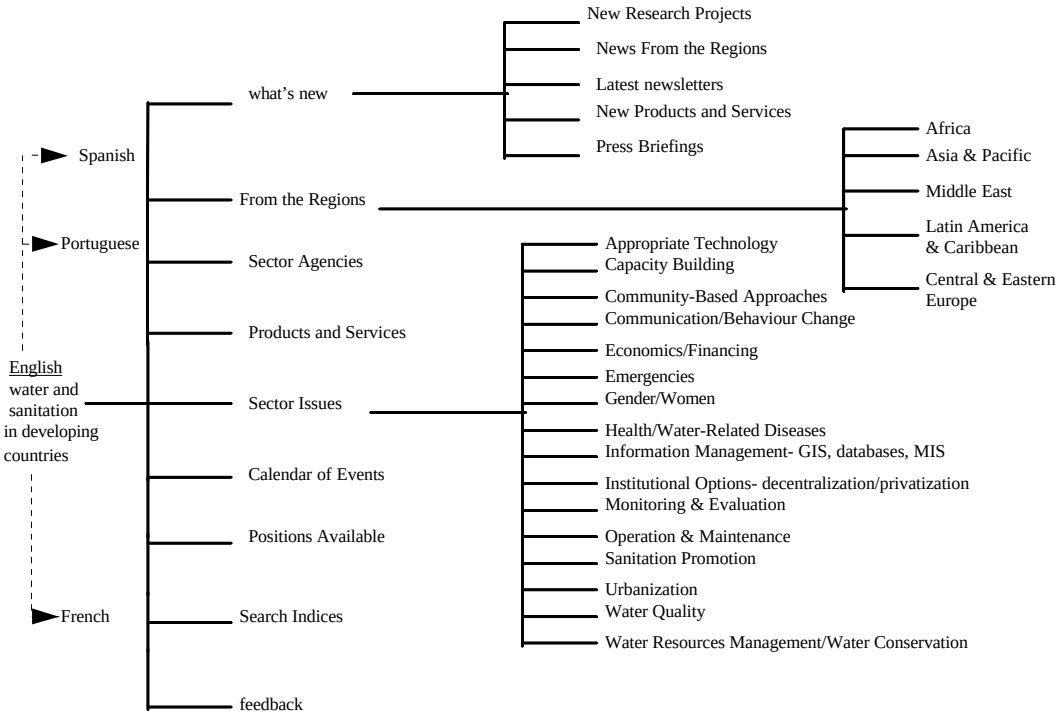

Fig 1: Logic flow in the prototype multifacetedInformation provider

This logic flow was then converted to equivalent links on the WWW which was then used to evaluate the potential usefulness of the proposed information provider. Within some links, some substantive information and links in particular were included. However, in most of the cases only the structure was established.

3.3. Evaluation and Analysis

Various approaches were used in an attempt at evaluating the effectiveness of the prototype information provider. In all, solution to two problems encountered in the field were attempted using the provider. Although, the problems described were technical in nature, the question of institutional problems being solved using the information provider were considered. However, more detailed treatment of the approach is beyond the scope of this paper. Theoretical solution to one of the problems was compared with the solution found through the information provider. Whereas the full description of the evaluation is given elsewhere (Kibata, 1996), this paper will only describe one of the several approaches that was adopted and the resulting deductions.

3.3.1 Umgeni Water: Iron and Manganese Removal Problem.

Figure 2 shows a typical terrain encountered in Kwa-Zulu Natal province of South Africa in design of water supply schemes. Water is to be abstracted from borehole B and pumped to the service reservoir at point A. At the bottom of the valley, power is available from the power lines at P but not at the top of the hill on point A. Road communication is possible at the bottom and not at the top of the hill. Thus if there is treatment to done requiring power, it is only feasible at the point labelled PTP in **Figure 2**. Hydraulic/economic calculations indicated that construction of two pumping stations would be too expensive. Thus any possible treatment at PTP had to be under pressure if only one pump was to be used.

Efaye - Mt. Elias water supply scheme and Swayimana water supply scheme are two such schemes in which Umgeni water was involved. The Efaye scheme consisted of 3 boreholes code named 1A, R2, and 1F in addition to surface water from Makeni river. These boreholes were projected to have a safe yield of 15, 6 and 8 m^3/h respectively. The Swayimana project was sourcing its raw water mainly from surface water sources. A borehole at Mazinganya was also to be used with a projected safe yield of 26 m^3/h with a daily pumping period of 10 h. Both projects were sampled at various times between 1993 and 1995.

Bacteriological examination revealed no faecal coliform present while other tests indicated low levels of various inorganic metal ions. From these tests, it was found that iron and manganese were in excess of the maximum allowable levels using the Umgeni Water drinking water standards. Ideally, it would have been possible to aerate the water in order to oxidise iron II to iron III which is more insoluble, then precipitate. Alternatively, the pH value of water could be increased to precipitate iron. The same principles could be used for manganese removal. This aeration would have necessitated a pressure break at point PTP in **Fig 2** and hence impractical. Bleeding in air through the pump's impeller was not possible because the pump could be submerged up to 20 m in water. Given the high pressure through which the water was being pumped, the flow into the reservoir could be adversely affected because air under pressure would expand on release at the reservoir inlet.

Whereas the raw water quality of the boreholes was within the recommended levels using the WHO standards, the more stringent Umgeni Water standards required some form of treatment for the water to remove iron and manganese. The treatment options available all required either pressure breaks or supply of power at the top of the hill i.e. point A in **Fig 2**.

A message was sent through the Internet to INTERWATER partner institutions. The message requested for information on simple methods of pH correction that can be used on the rising mains under pressure, information on dosing systems that do not require electricity, and information on green sand filters and other simple methods of iron and manganese removal in the field. From the level of response to the query, an interim conclusion on the effectiveness of the use of the Internet in the sector could be made.

Within 24 h, of circulating the information request to the INTERWATER partner institutions, it had been established that the problem of excess iron in drinking water had been experienced in India, Sri Lanka and Bangladesh. However, in those countries, manganese was not experienced as a problem. The lessons though learnt using iron have a scope for adaptation for use in manganese removal.

3.3.1.1. Background to the problem

WHO standards for potable water quality states that a level of 0.3 mg/l is the highest desirable level and that 1.0 mg/l is the maximum permissible level. The Umgeni Water potable water quality allow a maximum iron level of 0.2 mg/l. There are no direct health risks associated with the iron content levels usually found in groundwater, and the human body appears to require between 5 and 6 mg of iron per day. It should, however, be noted that iron bearing waters, particularly from

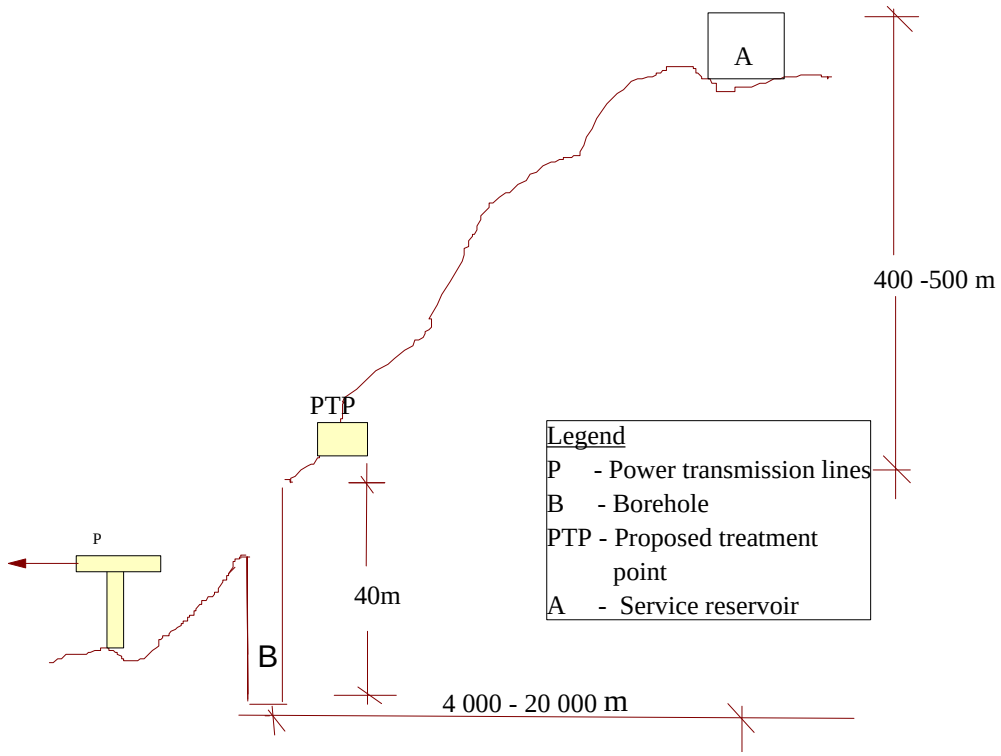

Figure2: Typical terrain encountered in KwaZulu Natal, South Africa, in design of water supply projects

shallow wells or reservoirs, can be carriers of micro-organisms, e.g. *Crenothrix*, which apart from clogging well screens and other equipment can have a detrimental health impact. Iron in water becomes objectionable because of its taste, clogging in taps, pipes and staining on clothes and stickiness in the hair. This clearly has an effect on the users' acceptance of the water. Badly affected supplies can have the effect of forcing the users to abandon an otherwise good and safe supply for a heavily contaminated and unsafe one[20].

Most groundwaters contain some iron, usually at a level below 5 mg/l, but concentrations up to and above 15 mg/l are common. High concentrations of iron are associated with deep well waters from

shale, sandstone and other rocks. The iron is dissolved by groundwater containing carbon dioxide but not oxygen[21].

3.3.1.2. Suggested low technology iron removal plant

Low technology iron removal plants developed for application in developing countries have depended on aeration-filtration techniques. Early models generally depended on removal and cleaning of filter media, either in bulk or as a top layer, for rejuvenation. It is one of these models that was suggested as a solution to the Umgeni Water iron and manganese problems from the Information request sent through INTERWATER.

One model used in Orissa, India, developed for use in rural areas with hand operated pumps, is sketched in **Fig 3** and illustrates the prototype model as developed in Denmark.

The filter unit is designed to operate at a hand pump capacity of 0.8 to 1.2 m^3/h. The prototype is constructed in steel and is 600 mm diameter by 1 000 mm long. The unit is approximately half filled with filter media and flow is downward through the tank, and outlet water is collected via a perforated pipe under the media. The unit is thus operating as a filter with a surface area of approximately 0.6 m^2 and a surface loading of 1.3 to 2 $m^3/m^2/h$.

When cleaning is required, the filter is disconnected from the inlet and outlet pipes and rotated on the bearings shown, thus agitating the filter media and releasing the trapped iron particles into suspension. After several rotations, the *dirty water* in the filter is discharged to waste, the filter is refilled with water and the cleaning operation is repeated. Three or four such washes have been shown to remove 85 to 95 % of the theoretically retained solids without removing media or entering the unit. This mode of operation has benefits from both effort and hygiene standpoint.

The principal on which the filter operates requires use of a single size media. Various trials have been carried out with differing size media and it has been found that a media of 0.4 to 0.8 mm size results in good effluent quality and filter runs. Effluent quality of 0.01 to 0.05 mg/l of iron was obtained from a raw water level of 3.55 to 8 mg/l. Filter runs of up to 300 m^3, or 30 days equivalent hand pump supply, have been found to be possible before filtrate quality starts to deteriorate. After this length of filter run, the head loss through the unit was recorded as 0.1 m.

The unit as operated in Orissa, India was connected to an existing public water supply treatment plant in which cascade aeration was included. Some type of aeration unit would need to be connected to the filter unit to provide a complete treatment system for iron removal.

3.3.1.3. Extent of solution of the problem

To a large extent, the basic questions posed were not answered i.e. search for simple methods of iron and manganese removal, simple methods of pH correction and simple methods of chlorine dosing that do not require power. However, the documents received produced a starting point in the search for solutions to this problem. Aeration combined with filtration was developed as a possible means by which the desired removal could be achieved. This is a feasible solution because aeration can be achieved at point of entry into the reservoir if the water is cascaded into the reservoir. However, filtration as suggested in **Fig 3** would require an occasional power supply to agitate the filter unit and remove the filtrate as well as personnel possibly on a part time basis.

This problem had an initial effect of proving that in some instances, various problems encountered in the field are likely to have been encountered elsewhere. Although a complete solution was not proffered, a starting point for further development was made.

3.3.1.4. Perceived Roles of the Internet in Water Supply and Environmental Sanitation for Developing Countries.

The Water Supply and Sanitation Collaborative Council (WSSCC) is a group of professionals from developing countries, external support agencies (ESAs), non-governmental organisations, and documentation and research organisations all working in the water, sanitation, and waste management sectors.

Given the nature of the Water Supply and Sanitation Collaborative Council, it was thought to be an ideal forum at which the potential effectiveness of the server could in principle be put to test. The Council's Third Global Forum on Water and Sanitation was held in Bridgetown, Barbados in November 1995. An audio-visual presentation on the project was made to the council's plenary session. A live demonstration of the prototype information server was provided throughout the duration of the conference. From the presentations and demonstration, a feedback from sector professionals in developing countries was obtained

After the information sever was presented to the WSSCC plenary session, the Council deliberated on the potential of the Internet in general and the information server in particular in the water and sanitation sector. Given the informal nature of the council, the Council saw an opportunity whereby its large pool of information could be shared at a much reduced cost because multiple copies need not be made. The Council recommended the information server be accepted as an official mandated activity of the council under its Information and Communication working group.

The objective of the Information and Communication working group is mobilisation for improved programme development in the water and sanitation sector through communication. It addresses social mobilisation for partnership among all stake holders based on interest and needs of people. It implies changes in behaviour including communities and decision makers. Communication processes which assist and stimulate behavioural changes are thus an integral part of the mobilisation that is recommended. The group achieves these objectives globally through advocacy and policy development and nationally through situation analysis of the country, joint programme strategy for improved programming, capacity building, learning projects on the ground, and programme evaluation. Thus in assigning the project to this working group, the council was defining the role of Internet in the sector advocacy.

The technical publications from the meeting were to be officially located in the information server. This defined another role in which the server in particular and Internet in general could be used to report on the activities of the sector from the field and transmit it onwards to sector professionals world-wide.

4 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS.

Various conclusions could be drawn with respect to the WENDY / INTERWATER project from the study. More importantly however was the fact that these conclusions would be applicable to all future Internet based initiatives on Water Supply and Sanitation for developing Countries and in particular dedicated to developing communities.

4.1. Discussion and Conclusions.

The following points can be noted from the work done in the study:-

- Two tests were conducted to test the potential effectiveness of the information server in solution of technical problems encountered in the sector in developing countries. The first was seeking simple methods of removal of iron and manganese from drinking water encountered by Umgeni Water. The problem was circulated to partner institutions in the INTERWATER project. From the answer given on the problem, it transpired that the problem had been encountered before in India, Bangladesh and Pakistan. The solution offered was not complete and could not be used without modification by Umgeni Water. However, useful background information on the removal of iron was provided. Further, the report received from INTERWATER partners ruled out the use of compressed air in the borehole, chlorination, and use of iron bacteria as possible simple treatment options. The decision was arrived by considering the technology that was simplest, cheapest and most realistic in the field. This possibly saved Umgeni Water some resources that would have been used investigating the options further. Most importantly, the hypothesis that problems encountered in the sector in developing countries can be solved using technology that has been tested elsewhere as long as there is a mechanism for information exchange was underscored.
- The potential effectiveness of the server was also sought from the views of the sector professionals. The Water Supply and Sanitation Collaborative Council designated the server as a potential tool for disseminating sector news, views and information at reduced costs. Its role in sector advocacy was also stressed. Sector advocacy is a powerful method of bringing about benefits of clean water supply and adequate sanitation. However, for the INTERWATER project to fulfil this role more effectively, greater access to the Internet for developing countries and higher profile of the project has to be ensured.

4.2. Recommendations and Scope for Further Work

- In order for Internet based initiatives on Water Supply and Sanitation for Developing Countries to successfully carry out their functions, it is important that they reach as wide an audience as possible. This can be carried out at three levels i.e. access to the Internet, use of popular languages and creation of awareness of their presence. Improving of access to the Internet in developing countries was beyond the scope of the project. The prototype information server was constructed using four languages i.e. English, French, Spanish and Portuguese. These were the languages for which translation resources were available. Other choice language whose use would improve the access to information held by Internet based initiatives on Water Supply and Sanitation for Developing Countries would be Chinese, Hindi, Arabic and Russian. Suggestions of *marketing* of Internet based initiatives on Water Supply and Sanitation for developing Countries as a starting point in realising the awareness about their presence had been made. The *marketing* would be through both the print and electronic media. Further, the information server should be registered with all the known search engines on the Internet.
- Priority should be given to the inclusion of available information on appropriate technology. This may stimulate research in this direction by documenting the state-of-the-art in research on the technology.

The server could also be used to reach out to the sector professionals and convince them that low technology solutions require as much research and engineering as high technology solutions.

- Circulation of technical problems among sector professionals through listservers proved to be an effective means of solving these problems. However, the listservers used were not specific to water and sanitation in developing countries although solutions did to related problems existed. It is recommended that such a listserver be established to discuss various issues on water and sanitation in developing countries.
- Internet access in developing countries is crucial in the realisation of the objectives of INTERWATER. Although provision of this access was beyond the scope of INTERWATER, the partner institutions in the project could be used to motivate on a long term basis for donors to avail funds to increase access to the Internet in developing countries.
- For the information provider to operate effectively as clearing house on information in water and sanitation in developing countries, the information held by the partner institutions has to be indexed in a standard manner. This would ensure a logical and uniform information flow and ultimately have an effect on the quality of information held.

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Appendix 1: Listing of Selected Internet Based Resources on Water Supply and Sanitation in Developing Countries.

Institution/ Site	URL
INTERWATER - Water and Environmental Sanitation Electronic Network for Developing Country Needs	www.oneworld.org/ircwater/iwindex.htm
Mvula Trust	www.mvula.co.za
Water Sector Development Group (Zambia)	www.zamnet.zm/wsdg
Umgeni Water	www.umgeni.co.za
WaterAid London	www.oneworld.org/wateraid/
International Reference Centre for Water and Sanitation (IRC), The Hague	www.oneworld.org/ircwater/index.htm
African Water Page	www.wn.apc.org/afwater/index.htm
Environmental Health Project (USAID)	http://www.access.digex.net/~ehp/
Water Engineering, Development Centre (WEDC) Loughborough, Britain	info.lut.ac.uk/departments/cv/wedc/
Garnet - Global Applied Research Network in the water supply and sanitation sector.	info.lut.ac.uk/departments/cv/wedc/garnet/grntover.html
Water Supply and Sanitation Collaborative Council	www.oneworld.org/ircwater/council.htm
UNDP-World Bank Water and Sanitation Program (TWUWS)	www-esd.worldbank.org/html/esd/twu/pub/water/watrlist.htm
APPROTECH ASIA: Centre for Appropriate Technology in Water and Sanitation.	www.pchrd.dost.gov.ph/aptec/index.html
Water Supply and Sanitation White Paper	www.polity.org.za/govdocs/white_papers/water.html
National Sanitation White Paper	wn.apc.org/opengov/sanit/sanittoc.htm

Appendix 2: Information Needs of Various End Users in Water and Sanitation Sectors of Developing Countries as Determined by Interview.

End user	Information needs
Consulting engineers	w design standards for projects in various countries w design methodologies adopted in various projects. w approach to feasibility studies in the water and sanitation sector w effluent disposal criteria and standards in different countries w applicable drinking water standards in developing countries w raw water quality in different countries w new methods, chemicals, equipment and techniques in water and waste water treatment.
Water authorities	w international trends in policy and institutional issues. w project funding sources. w regulatory legislation on water quality in force internationally. w water treatment
Municipal authorities	w policy issues in urban water supply and wastewater disposal. w policy issues on water and sanitation in peri-urban areas and informal settlements.
Engineering contractors	w information on innovations in water supply construction technology. w pre-qualification requirements for international tendering processes w details of upcoming contracts with a view to bidding
Government bodies	w potential sources of funds for new projects in water and sanitation sector. w impact of water and sanitation projects on development.
Communities	w information on the state of their environment w information of conformity of their aquatic environment with the international standards e.g. WHO guidelines for drinking water qualities.
non-governmental organisations	w social implications of presence/absence of adequate water supply and sanitation.

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End user	Information needs
Researchers and research agencies	w researchers need to be kept abreast of developments in the field. Thus new findings, papers etc. would be in need w there is a need to be informed of conferences and other fora in which researchers can present their findings. w a necessity to bridge the *grey literature* coming out of the field with the research that is in the mainstream scientific publications.
Aid organisations	w identification of potential needs of communities in developing countries in water and sanitation sector w comparison of parallel technologies in order to assess whether they are getting the best/most out of their money. w need to secure the cheapest and the most appropriate technology for the projects may be funded by these organisations.