GUIDELINES FOR IMPLEMENTING VOLUNTEER WATER QUALITY MONITORING IN SOUTH AFRICA

L Rossouw • DA Februarie

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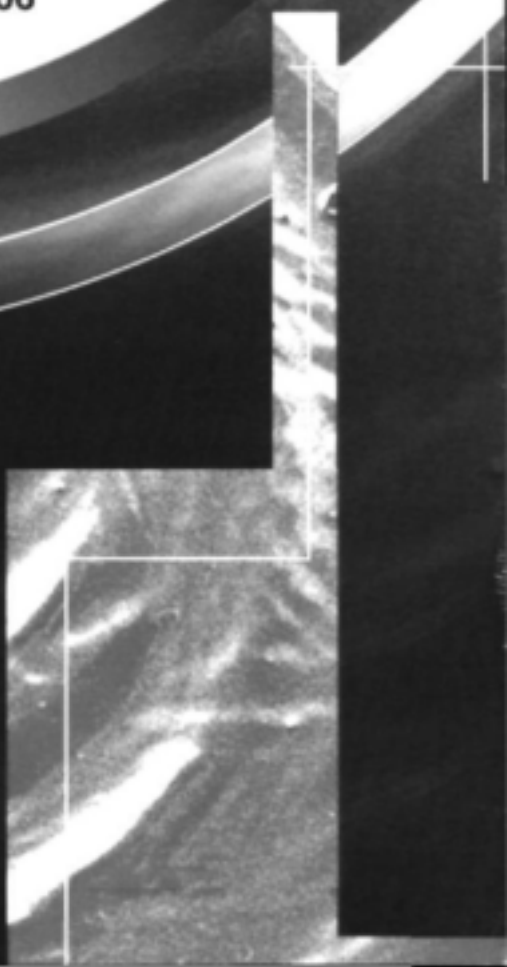

GUIDELINES FOR IMPLEMENTING VOLUNTEER WATER QUALITY MONITORING IN SOUTH AFRICA

by

L Rossouw* and DA Februarie+

MetsiQual*
Nosipho Consultancy+

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EXECUTIVE SUMMARY

The following words of Dr H van Niekerk from the Department of Water Affairs and Forestry (DWAF) highlight the need to investigate the principles involved in volunteer monitoring:

"As you are aware the National Water Act requires that DWAF must establish national water quality monitoring programmes as soon as practicable. During the design of the National Microbial Water Quality Monitoring Programme (NMMP) and National Eutrophication Monitoring Programme (NEMP) the importance of volunteer monitoring came to light. The actual implementation of monitoring programmes that are based on volunteer monitoring programmes has never been tested in South Africa and is currently proving to be more complicated than initially thought. I believe that it is about time that we start looking at the potential application of volunteer monitoring programmes, as the application thereof in the US has shown to be very successful."

There are a number of factors that indicate that it is probably an opportune time to examine the feasibility and implications of using volunteer monitors to support water quality monitoring networks in South Africa.

In addition, on the 8th of February 2002, our President, Mr Thabo Mbeki, called on the people of South Africa to volunteer their services with the following words, "We have it within us as a nation to join them and many others to forge a massive movement of volunteers - dedicated workers in all fields of life - and bring to life those enduring attributes of all our people, of perseverance and persistence in the struggle for our own good and the good of humanity."

However, there are factors that make the use of volunteer monitors less attractive. These include concerns about contractual buy-in from participants, health and safety aspects, coordination of participants and others.

The objective of this project is to define the field of volunteer monitoring, examine the constraints to volunteer monitoring, capture good practice lessons, and to document these as guidelines for implementing volunteer monitoring in South Africa.

Aims of the study

The development of guidelines for implementing volunteer water quality monitoring in South Africa was undertaken to:

- Identify and investigate different volunteer monitoring models in use nationally and internationally, their strengths and weaknesses, and good practices to enable water resource managers to identify opportunities where volunteer monitoring can support monitoring efforts.
- Document good practices in volunteer monitoring to enable water resource managers to plan and implement volunteer monitoring.
- Identify training requirements for volunteer monitors at different levels of competency to enable water resource managers to implement volunteer monitoring.
- Investigate the legal and health and safety implications for volunteer monitors that will identify legal and other constraints on the use of volunteer monitors.
- Create awareness amongst forums and other interested and affected parties on how they can contribute to water resource management by getting involved in volunteer monitoring.

Research design and methodology

In order to meet the aims of the project, the following tasks were undertaken:

Step 1: A literature and information review – The objective of the literature and information review phase is to gather and capture information on international (chapter 3) and local (chapter 4) experience in different forms of volunteer monitoring.

Step 2: Interviews with key stakeholders – The objective of this phase was to identify key stakeholders, and design and undertake interviews with the identified stakeholders.

Step 3: Liaison with other monitoring and capacity building initiatives – The objective of this phase was to identify and liaise with Government Departments and other monitoring and skills development initiatives from other organisations that also operate water-related monitoring, assessment and information systems. Steps 2 and 3 are discussed in chapters 2 (Methodology), 5 (Results and Discussion) and 6 (Recommendations).

Step 4: Volunteer monitoring workshop – The objective of this task was to arrange a workshop/session in 2004 to coincide with SASAqS 2004 in Johannesburg to present results, invite stakeholders and interested and affected parties to contribute towards our understanding and possible implementation practices of volunteer monitoring (chapter 5.4).

Step 5: Synthesis of information – The objective of this task was to produce a document on different volunteer monitoring models with their strengths and weaknesses and legal and health and safety aspects, good practices in volunteer monitoring and proposed training requirements for volunteer monitors.

Conclusions from the questionnaire

- There is a lack of capacity in the water sector and it was clear from the response to the questionnaires that there is a need to utilize volunteers in water quality monitoring. In order to implement the use of volunteers effectively, capacity needs to be developed. The training requirements should be identified by the stakeholders and will be project specific.
- The current skills and knowledge available in the water sector can be incorporated into the training process.
- Well-trained volunteers can play a vital role in assisting institutions to perform their functions effectively. The activities in the Olifants-Doorn Water Management Area have shown that by involving volunteers in the management of water resources and exposing them to training, not only do the institutions benefit, but communities become more aware of the urgency and importance of protecting our precious water resources.

Results from the interviews with individuals from water institutions

The results from the interviews with Rand Water, Umgeni and the City of Cape Town were presented in chapter 4, sections 4.2, 4.3 and 4.4 respectively.

- Rand Water and Umgeni Water have extensive water quality monitoring programmes, but do not make use of volunteers in their water quality monitoring activities. A number of concerns were raised concerning the use of volunteers:
  - Logistically it is very difficult to coordinate and get or collect samples, especially in remote areas.
  - Volunteers must be reliable.
  - Equipment needs to be supplied, increasing their costs.
  - Samples need to be delivered to the laboratories on time.

- Transport of samples to the laboratories and to the sampling sites especially in the remote areas is problematic.
- Volunteers may need to be remunerated for their transport costs.
- Health and safety of the volunteers is a concern, especially in remote areas.

- The City of Cape Town has trained and used volunteer water quality monitors in the past but it was on an ad hoc basis and various problems were identified:
  - The success rate is high when it was need driven e.g. where a community utilize a resource for recreational purposes (river), when it was an awareness campaign involving school learners, or when the data and information gathered were not used for a specific purpose other than creating awareness.
  - In most instances, no laboratory analysis took place.
  - A lack of funding, structure and specific skills within the community resulted in nobody taking responsibility for such a programme.

Interviews with individuals from other volunteer groups

The results from interviews with non-water related volunteer groups are also discussed in chapter 4.

- The main reasons for the success of the Volunteer Child Network are the following:
  - Ordinary citizens are used to help prevent, combat and minimise the impact of child abuse.
  - Appropriate and useful activities for volunteers have been identified.
  - The recruitment, training and management of the volunteers in a sustainable and productive way have been developed.
  - Guidelines on becoming a volunteer and making use of volunteers were also developed.

- The St John Ambulance Foundation is assisted by a network of professionals and trained instructors who give training in first aid and health promotion.

  Because of the well-structured training programme, the organisation attracts a diverse group of volunteers, e.g. community members, school learners, matriculants, professionals from different disciplines (accountants, health professionals, business, etc.) to enable them to assist people in need.

  Matriculants or unemployed people perceive the training as an opportunity to secure a job in the formal sector.

  The Foundation uses the following incentives:
  - Volunteers only receive travelling costs when they have to provide a service.
  - Certified training courses are provided.
  - Uniforms are provided when on duty (first aid volunteers). This gives the volunteer a sense of equal status to the professional paramedics.

Other volunteer monitoring groups that were identified locally are briefly listed below:

- Catchment fora are active in catchment management and the identification of problem areas (pollution, soil erosion, etc.) in the interim until Catchment Management Authorities are established. Although routine or baseline water quality monitoring is not part of their mandate, problem areas are identified and referred to the local authorities to investigate and solve the

problem. Volunteers from the different communities in a particular Water Management Area manage the fora.

- There are a number other volunteer groups such as the 'Friends of' groups. A small core of volunteers who are dedicated and motivated by local issues drives these kinds of groups.

- An interesting concept is where a volunteer has to pay to be part of a project such as the Threatened Species Project in the Greater St Lucia Wetland Park. British gap year students pay to come to South Africa and to work on research projects during their holidays. They stay anything from two weeks up to two months and sometimes even longer.

Interviews with individual volunteers
The question "What motivates a volunteer?" was asked to four people who have been involved in volunteer organisations as active volunteers.

The responses of all four people indicated that there was a reward in place for each of them. Even though the reasons for volunteering were different for each individual, there was a sense of "I am getting something out of this and at the same time, I am contributing towards society" for all of them.

Legal, health and safety aspects

- The labour law does not provide any protection and benefits for volunteers. It is suggested that labour laws be reviewed to include working conditions and protection for volunteers, especially their health and safety.
- Volunteers can be used for sampling if the Department of Water Affairs and Forestry appoints them. The powers and duties of such an authorised person are addressed in the National Water Act of 1998 in Chapter 13, Part 1, Article 125.
- Any water quality data that were attained legally can be used in court if the person that obtained the data went to the police and made a statement and is prepared to testify in court. However, it is unlikely that DWAF will go to court with data that was not obtained according to strict guidelines.

Volunteer monitoring workshop
People who were identified during the workshop as possibly being involved in or knowing about volunteer water quality monitoring were contacted after the workshop. However, there were no specific projects that used volunteers for water quality monitoring.

The general feeling from the work session was that people were keen to use volunteers on principle, but none have had experience of using volunteers in practice.

Lessons learned
The following are lessons learned from both the international and local case studies. They are not in a particular sequence and are all considered equally important. Should one lesson be ignored in the planning and implementation of a volunteer monitoring programme something can, and probably will, go wrong.

Institutional/governmental support and guidance
Provide mechanisms for different catchment organisations to coordinate activities, exchange ideas, and share experiences so that programmes are delivered as efficiently and effectively as possible.

Legislate catchment planning and ensure the integration of catchment management programmes into existing policy regulations and activities.

Develop a public awareness campaign aimed at increased understanding of the importance of catchment management.

Commit to building collaborative partnerships with communities, industry (including forestry, agriculture, mining and energy), all levels of government, and community groups.

The government and other water sector institutions should co-ordinate to develop a strategy for the use of volunteers in water quality monitoring and set policies for monitoring by volunteers.

Training

Well-trained volunteers can play a vital role in assisting institutions to perform their monitoring functions effectively.

A well-structured training programme is required. There are many training programmes currently available internationally and locally. A skills audit will identify the specific training requirements of a volunteer group and this must fit in with the objectives of their monitoring goals. Once this is done it is proposed that they tap into the various existing training programmes and select the most appropriate programme that will affectively address their needs. If nothing should be available one would have to source funding to develop a specific programme to suit their needs.

Acceptability of data

Volunteer monitors collect independent data that can be used to either uphold or challenge public agency and industry data. This opens previously closed doors for meaningful participation by citizens in environmental decision-making. This kind of dialogue leads to the mutual trust that is essential to co-operative efforts to solve environmental problems.

It takes time for volunteers to prove themselves to the scientific community or water managers. They have to prove that they are collecting good quality data that can be used for decision-making and not only for awareness campaigns. It takes a mindset change to value the data for what it is – good quality data.

Secure funding

It is critical to secure funding prior to the initiation and implementation of a volunteer project. It is just as critical to have a secure source of funding. It is even better to have multiple, secure sources of funding.

Responsibilities towards volunteers

Institutions must be aware of legal responsibilities towards volunteers. If there are no legal protective measures in place, the volunteers should be informed accordingly, before they commit themselves.

Lengthy process

Before volunteers can be used to perform monitoring functions, appropriate and clear guidelines should be developed to assist stakeholders in the initiation and implementation of the process of volunteer water quality monitoring.

It takes time to establish a monitoring programme of any nature. Proper planning is essential.

Start small

It is generally recommended that one should start small, i.e. with a pilot study, before full implementation of a monitoring project.

Commitment of volunteers

Volunteers must be inspired, motivated, keen and caring, to name but a few of the characteristics that will enhance their commitment to a specific volunteer monitoring programme.

The attitude of people plays an important role in their availability to participate in a volunteer monitoring programme.

Education

Education and awareness of environmental issues should start in schools. This way, a future generation that has an environmentally sensitive attitude will be created.

Public education and awareness programmes are an important component of catchment plans to build support for, and also encourage stakeholder participation in, catchment management.

Make connections

The more people you talk to in your community and within local and state agencies, the more friends and supporters your programme will have. Include potential data users in all phases of your project's development.

Incentives

It does not matter how committed a volunteer is, there must be incentives such as training (enhancing future work opportunities), feedback on work well done, valuable use of the collected data and acknowledgement of their contribution to their communities.

Another incentive is to create an opportunity for volunteer leadership development.

Report findings to volunteers and to the community. Help volunteers present monitoring results at conferences and community meetings. Create a newsletter or data report and let the world see what the volunteers have accomplished.

Pamper your volunteers

Volunteers give up their free time to come to meetings, attend training sessions, and travel to monitoring sites. Provide social opportunities and reward volunteers for a job well done.

Short-term versus long-term monitoring

Short-term water quality monitoring that is project based and community-initiated and driven has a better chance of success than long-term ongoing routine monitoring, as long-term monitoring does not produce the same kind of immediate, visible results as the smaller projects.

Partnerships

Partnerships are the core of a volunteer water quality monitoring programme. These can be between public and private sectors, between public and government departments/agencies or between public and learning sectors or any combination of these. These partnerships can be based on a number of approaches.

The bottom-up approach is more effective at building a sense of community and an appreciation for the power of organised groups. It gives the volunteers a sense of ownership of the project, and encourages them to become environmental stewards and advocates committed to seeking community unity for action. It also leads to a higher level of understanding and empowerment. The other partner provides the specific protocol, training, supplies, and equipment. The volunteers provide the manpower.

There are also benefits to a top-down approach. Some volunteers prefer to work on a "ready made" project rather than investing the time and energy required for community-designed programmes. Furthermore, the greater the degree of institutional control over study design, methods, and data analysis, the greater the possibility of more robust data that are more acceptable to the scientific community.

Coordination

The coordination of any water quality monitoring programme is crucial to its success. The coordinator is responsible for keeping the volunteers, the funding agency, as well as all other partners involved in a specific monitoring programme informed about all aspects of the project.

Don't underestimate volunteers

Never underestimate the capabilities of volunteer monitors. They relish the challenge, but more importantly, they want to collect high quality, usable data because they want their effort to count for something (Fuller, 2004). They should be seen as equal partners in a monitoring programme.

Cultivate data users

One of the fundamental lessons is the importance of engaging data users right from the start. The data needs guide the selection of the monitoring protocols. Taking the necessary steps to ensure that volunteer-collected data will be used is closely tied to the "don't underestimate volunteers" principle. People who put in time and effort for training and monitoring do not want their commitment treated lightly and they do not want their data treated lightly (Fuller, 2004).

Challenges

Institutional support	- Creating technical support for regional and local structures in developing and implementing water resource quality monitoring plans. - The establishment of a National Monitoring Council to support monitoring activities and provide strategic direction and policies for monitoring in SA.
Funding	Adequate funding is a key component of any resource quality monitoring programme. Monitoring programmes become costly as a result of a need for equipment (both laboratory and field) and other expenses. Operation and maintenance of a monitoring programme, chemicals, the process of information dissemination and training of the monitors are all expenses that need to be provided for before a monitoring programme can be initiated.
Legal issues	The labour law does not provide any protection and benefits for volunteers. It is suggested that labour laws be reviewed to include working conditions and protection of volunteers, especially their health and safety.
Logistics	Transportation of samples, especially from remote rural areas, can become an obstacle, especially if water samples have to reach a laboratory before a certain time.
Training and capacity building	A variety of skills exist within the Department of Water Affairs and Forestry, other institutions (i.e. Umgeni and Rand Water, SABS and CSIR)

	and communities. An effort should be make to match the skills with the needs of the monitoring programmes. Monitoring programmes must be kept abreast of developments in the Catchment Management Agencies and delegation of monitoring responsibilities over time.

Recommendations on starting a volunteer monitoring initiative
A strategy or policy framework will need to be developed in South Africa before the implementation of any, especially long-term, volunteer monitoring can even be considered.

Starting out in volunteer monitoring is a major challenge and "Guidelines to get started as a volunteer monitor" are presented in Appendix I, highlighting the major issues that should be addressed when initiating a volunteer monitoring activity.

Recommendations on skills development and capacity building
Water resource management will only succeed if skills development and capacity takes place in all relevant organisations and agencies responsible for water services at all levels.

It must be recognised that the level and focus of the capacity building will differ from group to group and even on an individual basis. The specific role, function and responsibilities of individuals or groups combined with existing level skill, knowledge and awareness will serve as the basis to determine the type of capacity building that will be required.

Guiding principles of capacity building as proposed by Grobler and Ntsaba (2003):

- Ensure that the key stakeholders and priority issues are targeted to meet priority water quality monitoring outcomes of the country.
- Encourage partnerships between stakeholders, especially between responsible institutions.
- Value and build on existing capacity, local expertise and knowledge.
- Capacity building should be based on learning from each other through sharing resources, experience, and expertise, both locally and internationally.
- Capacity building should be based on principles of trust, mutual reciprocity and norms of action (consistency and adherence to agreed upon methods).
- "Learning by doing" and other appropriate learning styles should be used.
- Value and utilize local community expertise and knowledge.
- Capacity building should be accessible to the entire community (general public).
- Capacity building should be based on access to accurate, scientific and technical information.
- Capacity building should contribute to building human and social capital.

They emphasised the following:

The important intermediate outcomes of capacity building relate to:

- Awareness to create attitude, behaviour and practice change through user education.
- Information and knowledge.
- Development of the necessary skills and competencies, institutional support and collaboration.
- Funding.

The value of volunteer involvement in water quality monitoring programmes
It has been acknowledged that the future of our water resources and sustainability thereof are dependent on the attitude of the users thereof, and in this instance, the role of community members cannot be ignored or underestimated. It is important that communities be made aware of the significant role they can play to preserve and protect our country's water resources.

Any skills development programme must be informed by community participation/consultation of all stakeholders and the outcomes of a needs analysis of that specific community.

Even the new Water Act of 1998 emphasises the need for community involvement at all levels within the water sector.

To assist water resource quality managers and users to deal with these complex issues, the Department of Water Affairs and Forestry, in partnership with other institutions and the private sector, should build on previous initiatives by making further investments through long-term strategic capacity building programmes. The focus should be on addressing all capacity building requirements of water monitoring. By investing in such programmes and promoting the involvement of communities and volunteers, the value and protection of our water resources will become less complex.

Goals of a training and capacity building programme

According to Grobler and Ntsaba, the capacity building programme must address the needs of all the functional components of a monitoring programme (data acquisition, data storage and management and information generation and dissemination).

However, these functional components on their own are not sufficient for operating a monitoring programme. They are to be accompanied by the following:

- Design and upgrading of monitoring programmes
- Research and development
- Coordination, communication and collaboration
- Public participation and public relations
- Skills development and training
- Appropriate funding

In summary, the training programme should not only make provision for technical training, but should also include non-technical components such as life skills.

Volunteer recruitment

For the past four years the Department of Water Affairs and Forestry has been involved in a process to mobilise community participation through the Integrated Water Resource Management Programme. Stakeholders and interested parties ranges from all spheres of Government, NGOs, Water Boards, Water User Associations and Catchment Management Forums. The latter consists of all stakeholders involved on a local level. The broad representation within the Catchment Management Forums makes them an ideal tool for the selection of volunteers. It is important that volunteers with the right attitude and a passion for the protection of water resources be involved in monitoring and training programmes on a community level. Local community members often possess valuable indigenous knowledge of water resources in their communities. In most instances they have developed a good track record of community involvement.

The skills and knowledge of members within Water Boards and Water User Associations should be optimally explored and they must commit themselves to transfer those skills and knowledge to monitoring programmes. In this process, the principle of collaboration and cooperation can be strengthened.

Proposed training areas

The Department of Water Affairs and Forestry developed an integrated training and capacity building programme. The training programmes are aligned with the South African Qualification Framework to ensure recognition and certification of participants.

These training programmes are briefly discussed in Appendices B to F for the technical training requirements and Appendices G and H for the non-technical related requirements.

This is one example of existing training programmes. Umgeni and Rand Water, for example, have their own well-structured training units, which are responsible for the development of training materials and presentation of courses.

If a new volunteer monitoring group is established, a needs assessment on their training requirements must be completed. This will depend on the objectives of their monitoring. Once this is done, it is proposed that they tap into the various existing training programmes and select the most appropriate programme that will affectively address their needs. If nothing is available, one would have to source funding to develop a specific programme to suit their needs.

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Appendix I: Guidelines to get started as a volunteer monitor

1. BACKGROUND

1.1 Background to the status of the water resources in southern Africa

Water has always been central to human life – so central that civilization began near rivers. In South Africa, Cape Town, Port Elizabeth and Durban grew as major ports of the region. Water has been described as the "single most important resource for our future" and "the pivot on which all future development depends" (SADC, IUCN & SARDC, 1996).

Today, water still dominates our life. Its presence continues to govern the locations of homes and cities; its unavailability causes death among people, animals and plants. Its intrinsic value may cause or exacerbate conflict, not only between states, but also between communities.

The people of southern Africa have a rich heritage of managing and living with their environment, including water. Traditional African societies have demonstrated themselves to be effective custodians of water. Rainfall and water were central to their lifestyle, influencing the activities in which they were involved.

In the case of modern southern African societies, population growth has added a new dimension to the demand for water and the associated demand for other resources, especially food. The demands on water in southern Africa are constantly growing with the rapid increase in population. With an average three percent annual growth rate, the population in the SADC region was expected to double in less than 25 years, from about 145 million in 1995.

As demands for potable water have increased worldwide over the years, so have human impacts on freshwater and marine systems. Water used for domestic purposes, industry, agriculture or mining is frequently returned to its original source polluted or contaminated.

Other major environmental impact issues – apart from population growth, poverty and economic development – include use of energy sources, soil erosion due to land use practices, river and dam siltation, sustainable use of wildlife resources, desertification and global warming.

Sustainable development has been described as the ability of the present generation to utilize its environment (resources) without putting at risk the ability of future generations to do likewise. These resources include water. Meeting today's needs and those of the future will require a reorientation of social attitudes, particularly the belief that water is an abundant natural resource available at no or low cost, when in fact it is an essential commodity which is becoming scarcer and more valuable through increasing competition. The wise use, management and conservation of this finite resource therefore depends on the people of the region (SADC, IUCN & SARDC, 1996).

One aspect of water resource management is the monitoring of the water quality for the different water use requirements. The Department of Water Affairs and Forestry is responsible, in terms of the National Water Act (Act No 36 of 1998), for the operation and maintenance of national water quality monitoring and assessment programmes.

By monitoring rivers, streams and dams, one is provided with an indication of catchment health. Monitoring over time can provide information on the state of the environment to assist with the maintenance and rehabilitation of our waterways.

Monitoring can:

- Establish baseline conditions in an over-polluted stream
- Establish the normal range of a particular water quality indicator such as the salinity of groundwater
- Identify trends in water quality over time
- Screen for potential water quality problems
- Raise awareness of the local community or stream users to encourage pollution prevention and ownership (stewardship) of the local environment
- Identify actions that can be taken and by whom, to help reduce or fix water quality problems

However, given the wide distribution of our water resources and the limited amount of funds and manpower available, the water quality of many water sources is not monitored.

Alternative ways need to be investigated to enhance/supplement the current water quality monitoring systems in South Africa. A Strategic Framework for Monitoring of Water Resource Quality was drafted for the Department of Water Affairs and Forestry.

1.2 Strategic framework for national water resource quality monitoring programmes

There is an old and well-proven management principle that states, "If you can't measure it, you can't manage it". This principle applies as much to water resource management as it applies to managing any other kind of human activity. This principle is recognised explicitly in Chapter 14 of the National Water Act (Act No 36 of 1998) (NWA), which requires monitoring of water resource quality to be an integral part of water resources management in South Africa. The NWA mandates the Minister of Water Affairs and Forestry to establish national monitoring systems that monitor, record, assess and disseminate information regarding, amongst many other things, the quality of water resources (DWAF, 2004).

The National Water Resources Strategy (NWRS) recognises that no single monitoring programme can lead to a comprehensive description of the "state of the water environment". There is a need to implement and maintain different monitoring systems to provide information on different aspects of water resource quality. This is confirmed by the fact that several water resource quality monitoring programmes currently exist both within the Department of Water Affairs and Forestry (DWAF) and in several other institutions involved in water resource management.

The purpose of monitoring can be defined as: "Delivering the management information about water resource quality they require to water resource managers, planners and other stakeholders in the appropriate format, at the right time". This information user-centric approach currently being used to design monitoring programmes requires that the scope of monitoring includes the following three core functions:

- Data acquisition
- Data management and storage
- Information generation and dissemination

All of these functions are supported by an IT support infrastructure. The next overlay on the framework is the three portfolios of monitoring programmes that are the responsibilities of the three tiers of water resource governance in SA, namely:

- A portfolio of National Monitoring Programmes led and maintained by the Department of Water Affairs and Forestry's Policy and Regulation branch

- A portfolio of Regional or Catchment Monitoring Programmes which are the responsibility of Catchment Management Agencies and the Operations branch of the Department of Water Affairs and Forestry
- Portfolios of Local Monitoring Programmes that are the responsibility of local institutions and/or water users

There is scope for the sharing of infrastructure and resources between the three tiers of monitoring as well as data collected at different tiers, if they are consistent and comply with minimum quality requirements.

Water resource management approaches and practices change with time. Therefore, in order to remain relevant, monitoring programmes need to be reviewed from time to time to confirm that they still meet their users' information requirements and be revised if necessary.

Up to now, with the exception of two or three major Water Boards and the larger city councils and municipalities, most water resource quality monitoring in SA was funded and executed by DWAF. Although staff at DWAF's Regional Offices handled most of the actual data acquisition, a few DWAF Head Office directorates (HO) performed virtually all the data management and storage and information generation and dissemination functions. These HO directorates were also responsible for designing and maintaining most of the resource quality monitoring programmes. Therefore, the bulk of water resource quality information currently being produced in SA is obtained from monitoring programmes operated by DWAF HO.

The new institutional set-up for water resource management in SA has profound implications for how water resource quality monitoring in SA will be conducted from now on:

- Many of the water resource management functions previously performed by DWAF are now to be performed by CMAs and other water management institutions (or DWAF Regional Offices acting on their behalf). As a result, these institutions now also become primary users for most of the water resource quality information that was until now only required by DWAF for performing its water resource management functions.
- CMAs and other water management institutions are expected to operate the monitoring programmes required to produce the water resource quality information they need for performing their functions.

The awareness of the need for a more integrated and coordinated approach to water resource quality monitoring has existed for quite some time. Several years ago, DWAF initiated the definition and development of a comprehensive water resource quality "Monitoring Assessment Information System" (MAIS).

The requirements of the NWA and the establishment of the required water management institutions are now proceeding rapidly. A strategic framework for the monitoring of water resource quality is, therefore, urgently needed to enable DWAF and the other water management institutions to:

- Ensure that the provision of all the water resource quality information necessary for integrated water resource management is adequately addressed
- Serve as a basis for clarifying the roles and responsibilities of all of the stakeholders involved in providing the required water resource quality information for managing water resources from the strategic/national to the local level
- Serve as a basis for redesigning/restructuring/rationalising existing water resource quality monitoring programmes

- Ensure that water resource quality monitoring programmes currently being planned or developed are in line with the requirements of the NWA, the NWRS and the other requirements of DWAF
- Support effective and coordinated governance of water resource quality monitoring at all levels (local, catchment, strategic/national) and by all the different institutions involved in water resource management. Governance also needs to address the interfaces between the different national government departments that are stakeholders in water resources management, e.g. Department of Environment Affairs and Tourism, National Department of Health, National Department of Agriculture, Department of Mineral and Energy Affairs, etc. (DWAF, 2004)

The proposed framework must also consider some important issues in any redesign/restructuring/ rationalisation of water resource quality monitoring in SA:

- Water resource quality monitoring is expensive, often requires sophisticated technologies, and depends on access to specialists with scarce skills.
- There are likely to be significant overlaps between both the objectives and the operational components of water resource quality monitoring programmes required to produce information at the local, catchment and national/strategic level.

The use of volunteers to assist with water resource quality monitoring was not addressed in the strategic framework for water quality monitoring.

1.3 Motivation for the study

The following words of Mr H van Niekerk from DWAF highlight the need to investigate the principles involved in volunteer monitoring:

"As you are aware the National Water Act requires that DWAF must establish national water quality monitoring programmes as soon as practicable. During the design of the National Microbial Water Quality Monitoring Programme (NMMP) and National Eutrophication Monitoring Programme (NEMP) the importance of volunteer monitoring came to light. The actual implementation of monitoring programmes that are based on volunteer monitoring programmes has never been tested in South Africa and is currently proving to be more complicated than initially thought. I believe that it is about time that we start looking at the potential application of volunteer monitoring programmes, as the application thereof in the US has been shown to be very successful."

There are a number of factors that indicate that it is probably an opportune time to examine the feasibility and implications of using volunteer monitors to support water quality monitoring networks in South Africa.

1. In many catchments, DWAF is in the process of replacing outdated chart flow recorders with data loggers. Water quality monitoring sites are mostly linked to the gauging stations. One implication of this development is that staff from the regional office would visit these gauging stations at a lower frequency, hence also collecting water quality samples at a lower frequency.
2. One of the clear conclusions of the recent water resource situation assessment studies by DWAF was that remote areas were poorly monitored due to constraints on resources (human and running costs).
3. A large number of catchment and Water Management Area (WMA) forums have been established or are in the process of being formed as part of the Catchment Management Agency (CMA) establishment process. Most forums have established water quality groups and

feedback from these groups is that they are keen to get involved in monitoring to expand their knowledge of the catchment and to identify pollution sources. Volunteer monitoring presents a way of mobilizing the enthusiasm that has been created in the CMA establishment process.

4. The NWRS (DWAF, 2002) states that "An important component of the monitoring and assessment strategy will be to develop cooperative, collaborative relationships between the Department and other organisations which also operate water-related monitoring, assessment and information systems, to ensure that appropriate mechanisms and procedures are implemented to coordinate the monitoring of water resources." Water users referred to in this section can therefore include volunteer monitors.
5. The implementation models that were developed for the NEMP and NMMP rely to a large degree on local involvement via formal institutions active in the area of interest.
6. There have been a number of initiatives in South Africa to introduce learners and other interest groups to monitoring (see examples on the Umgeni (www.umgeni.co.za) and Rand Water (www.randwater.co.za) web sites). However, this did not lead to the use or integration of volunteers into the formal monitoring networks of organisations.

In addition, on the 8th of February 2002, our President, Mr Thabo Mbeki, called on the people of South Africa to volunteer their services with the following words, "We have it within us as a nation to join them and many others to forge a massive movement of volunteers – dedicated workers in all fields of life – and bring to life those enduring attributes of all our people, of perseverance and persistence in the struggle for our own good and the good of humanity."

However, there are factors that make the use of volunteer monitors less attractive. These include concerns about contractual buy-in from participants, health and safety aspects, coordination of participants and others. These, and other issues, will be addressed in this report.

The objective of this project was to define the field of volunteer monitoring, examine the constraints on volunteer monitoring, capture good practice lessons and to document these as guidelines for implementing volunteer monitoring in South Africa.

1.4 Aims of the study

The development of guidelines for implementing volunteer water quality monitoring in South Africa will be undertaken to:

- Identify and investigate different volunteer monitoring models in use nationally and internationally, their strengths and weaknesses and good practices to enable water resource managers to identify opportunities where volunteer monitoring can support monitoring efforts.
- Document good practices in volunteer monitoring to enable water resource managers to plan and implement volunteer monitoring.
- Identify training requirements for volunteer monitors at different levels of competency to enable water resource managers to implement volunteer monitoring.
- Investigate the legal and health and safety implications for volunteer monitors that will identify legal and other constraints on the use of volunteer monitors.
- Create awareness amongst forums and other interested and affected parties on how they can contribute to water resource management by getting involved in volunteer monitoring.

1.5 Research design and methodology

In order to meet the aims of the project, the following tasks were undertaken:

Step 1: A literature and information review – The objective of the literature and information review phase is to gather and capture information on international (chapter 3) and local (chapter 4) experience in different forms of volunteer monitoring.

Step 2: Interviews with key stakeholders – The objective of this phase was to identify key stakeholders, and design and undertake interviews with the identified stakeholders.

Step 3: Liaison with other monitoring and capacity building initiatives – The objective of this phase was to identify and liaise with Government Departments and others monitoring and skills development initiatives from other organisations that also operate water-related monitoring, assessment and information systems. Steps 2 and 3 are discussed in chapters 2 (Methodology), 5 (Results and Discussion) and 6 (Recommendations).

Step 4: Volunteer monitoring workshop – The objective of this task was to arrange a workshop/session in 2004 to coincide with SASAqS 2004 in Johannesburg to present results, invite stakeholders and interested and affected parties to contribute towards our understanding and possible implementation practices of volunteer monitoring (chapter 5.4).

Step 5: Synthesis of information – The objective of this task was to produce a document on different volunteer monitoring models with their strengths and weaknesses and legal and health and safety aspects, good practices in volunteer monitoring and proposed training requirements for volunteer monitors.

1.6 Report outline

This report is written about volunteer water quality monitoring around the world (chapter 3 – Literature Review of International Experience) and in South Africa (chapter 4 – Review of Local Experience) in an attempt to determine the feasibility of volunteer water quality monitoring in South Africa.

The process followed to determine the feasibility of volunteer water quality monitoring in South Africa is described in chapter 2.

The results and a discussion of the results from the questionnaire sent out to the identified stakeholders are presented in chapter 5, as well as the results from interviews with a number of individual volunteers.

Lessons learned, conclusions on the viability of volunteer water quality monitoring in South Africa, and some recommendations on the use of volunteers are presented in chapter 6. The focus of the recommendations will be on operational activities rather than on strategies to initiate/enhance volunteer water quality monitoring, as a strategic or policy framework does not exist in South Africa.

2. METHODOLOGY

2.1 Literature and information review

The objective of the literature and information review phase was to gather and capture information on local and international experience in different forms of volunteer monitoring.

Literature on international experience was mainly retrieved from the Internet (Google), and local reports were extracted from different websites. Some of the authors of the articles on case studies were also contacted by e-mail to gather information on the costs of the different volunteer monitoring programmes.

2.2 Identification of stakeholders

The objective of this phase was to identify key stakeholders, and design and undertake interviews with the identified stakeholders (institutions, communities, forums and service providers such as Rand Water and Umgeni Water). The database of DWAF and other institutions was used to identify and select key stakeholders. The information received via the databases was telephonically verified. Once the stakeholders were identified, a questionnaire was designed and sent out to the stakeholders to gather information on a countrywide basis on the use of, or lack of use of, volunteer monitors and specific issues relating to their current monitoring programmes.

The type of research study was mainly explorative in nature, with the purpose to identify critical issues relating to the use of volunteers for water quality monitoring. A self-administrative questionnaire was used to collect the empirical data to give effect to the aims of the study.

The questionnaire and information letter was sent out to 1280 key stakeholders. From the mentioned respondents, only 44 completed their questionnaires and sent them back. The following sectors of key stakeholders were identified and selected as research respondents:

- Water Boards
- Irrigation Boards/Water User Associations
- Municipalities:
    - Metro Municipalities
    - District Municipalities
    - Local Municipalities
- Tribal Authorities
- Conservancies
- Catchments Management Forums
- Community Based Organisations
- Wildlife and Environmental Organisations
- Commercial Farmers Associations
- Emerging Farmers Associations

The above-mentioned stakeholders indicate that the selected respondents are a representative group of the research universum (institutional water service providers, managers of water resources and concern groups in the water sector).

The questionnaire was sent out to the mentioned respondents on 29 September 2003 and they were given one month to reply.

2.3 Interviews

Visits to Rand Water and Umgeni Water were also planned, as they are generally regarded as the largest water suppliers in our country. Detailed discussions with them regarding their different water quality monitoring programmes and proposed use of volunteer monitors were held on 2 and 3 March 2004 respectively. The Rand Water interview was with Ms Leoni Grobler (with written input from Mr Francois van Wyk, the Head of Catchment Management). The Umgeni Water interview was with Mr Dean Simpson and Ms Lynne Archer.

In future, catchment management agencies (CMAs) will be responsible for monitoring the status of their water resources. Discussions were also held with role players involved in the process of establishing CMAs to identify the support required by these organisations (i.e. Olifants-Doorn WMA Reference Group).

An interview was also held on 9 February 2004 with Mr Craig Hartley from the St John Ambulance Foundation, as they make extensive use of volunteers.

Mr Randall Adriaans from the City of Cape Town was also interviewed on 4 May 2004 on their use of volunteers in their water quality monitoring programmes.

Volunteers involved in various sectors were interviewed to determine what motivates them to provide their services to community initiatives.

2.4 Legal, health and safety aspects

Hadley Cabin from DWAF Legal Services was contacted for information on the legality of water quality samples taken by volunteers.

Information was obtained from the National Department of Labour to determine the status of volunteers in terms of the labour law.

2.5 Volunteer monitoring workshop

The objective of this task was to arrange a workshop/session in 2004 to coincide with a conference to present results, invite stakeholders and interested and affected parties to contribute towards our understanding and possible implementation practices of volunteer monitoring.

3. LITERATURE REVIEW OF INTERNATIONAL EXPERIENCE

The literature review was divided into international and local experience. The review of local experience was based on literature and interviews with different organisations in the management of water resources.

From the international literature available on the Internet, it was clear that the major role players in terms of having a well-organised formal volunteer monitoring network were the United States of America and Australia.

Canada was identified as a role-player that has a well-defined policy in place to expand and strengthen catchment stewardship.

3.1 United States of America

3.1.1 Starting out in volunteer monitoring

The following is based on the U.S. Environmental Protection Agency (USEPA) model for volunteers in water quality modelling (USEPA, 1998):

What is a volunteer water monitor?

A volunteer monitors the condition of streams, rivers, lakes, reservoirs, estuaries, coastal waters, wetlands and wells because they want to help protect the water environment near where they live, work or play. Their efforts are of particular value in providing quality data and building stewardship (ownership) of local waters.

Volunteers make visual observations of habitat, land uses, and the impacts of storms; measure the physical and chemical characteristics of waters; and assess the abundance and diversity of living creatures – aquatic insects, plants, fish, birds and other wildlife. Volunteers can also clean up garbage-strewn waters, count and catalogue beach debris, and become involved in restoring degraded habitats.

Funding

Volunteer monitoring programmes can be organised and supported in different ways. Projects may be entirely independent or may be associated with state or local agencies; with environmental organisations; or with schools and universities. Financial support may come from government grants, partnerships with business, endowments, independent fundraising efforts, corporate donations, membership dues, or a combination of these sources.

The key is that funding must be available. The people volunteer their time to monitor the water environment, but there are expenses that need to be funded such as sampling equipment and the analysis of samples.

Volunteer monitoring resources

In the USA, the USEPA supports volunteer monitoring by sponsoring national conferences, publishing methods manuals, producing a nationwide directory of volunteer programmes, and funding a national newsletter, *The Volunteer Monitor*. *The Volunteer Monitor*, published twice yearly, is the national newsletter of volunteer water monitoring. The newsletter facilitates the exchange of ideas, monitoring methods, and practical advice among volunteer monitoring groups across the country. The newsletter also focuses on stories of successful monitoring programmes.

Volunteer coordinators in the ten EPA Regional Offices provide some technical assistance for local programmes and help coordinate region wide conferences. The Regions are also responsible for grants to the states that can be used, in part, to support volunteer monitoring programmes that help assess non-point sources of pollution or that serve to educate the public about non-point source issues.

Volunteers provide quality data

Many volunteer groups collect data that supplements the information collected by state and local resource management and planning agencies. These agencies use the data to:

- Screen water for potential problems, for further study or for restoration efforts
- Establish baseline conditions or trends for waters that would otherwise go unmonitored
- Evaluate the success of best management practices designed to mitigate problems

In general, a volunteer monitoring programme works cooperatively with state and local agencies in developing and coordinating its technical components. To ensure that its data are used, the monitoring programme also develops a strong quality assurance project plan that governs how volunteers are trained, how samples are collected and analysed, and how information is stored and disseminated.

Volunteers build stewardship of local waters

By educating volunteers and the community about the value of local waters, the kinds of pollution threatening them, and how individual and collective actions help solve specific problems, volunteer *monitoring programmes*:

- make the connection between catchment health and individual and collective behaviours;
- build bridges among various agencies, businesses, and organisations; and
- create a constituency for local waters that promotes personal and community stewardship and cooperation.

Volunteer groups whose primary purpose is education and constituency-building generally adopt simple, easy-to-use assessment methods and may not need to develop a stringent quality assurance project plan.

The following sections (3.1.2 to 3.1.8) are case studies involving volunteers in water quality monitoring in the United States of America.

3.1.2 The ALLARM Program (Alliance for Aquatic Resource Monitoring)

(Wilderman C., A. Barron, and L. Imgrund 2003)

This is a college (Dickinson) - community partnership started in 1986 to collect more information about the impact of acid deposition on Pennsylvania's streams. The majority of their effort is devoted to helping community groups perform their own monitoring and research on issues of their own concern.

"Citizen science" projects, including volunteer monitoring, rely on partnerships between citizens and professional scientists. These partnerships can take many forms, which can be arranged along a continuum of increasing community involvement and control. ALLARM's experience of evolving from a single-issue, "top-down" programme to a multi-issue, "bottom-up" programme has given the college insights into the strengths and challenges of the different models.

The following five questions help define a given partnership along the "top-down - bottom-up" continuum:

- Who defines the problem?
- Who designs the study?

- Who collects the samples?
- Who analyzes the samples?
- Who interprets the data?

At one end of the continuum is the "community workers model". The role of citizen volunteers is limited to sample collection, while professional scientists define the problem, design the study, identify the goals and methods, and do the analysis and interpretation.

At the other end of the spectrum are partnerships that involve maximum community control and participation. In this "community-based participatory research" or "science by the people" model, community members identify their concerns and are then trained by the supporting institution to design the study, collect the data, analyze and interpret the results, and turn the data into action. Both sides of the spectrum are valuable, but they have different strengths. In between these two extremes many variations exist.

As the volunteers in the original ALLARM program became more knowledgeable about their streams, many wanted to investigate other issues in addition to acid rain. A full-time director was appointed to reshape ALLARM into a partnership whose agenda would largely be set by the community.

The more control ceded to watershed organisations, the harder ALLARM's professional and student staff have had to work.

Right from the beginning, responding to community concerns meant choosing and developing methodologies for analysing new chemical parameters and training volunteers to perform them.

Initially, their new community-centred approach did not extend to the first (study design) and last (data analysis and interpretation) steps in the watershed assessment process. But as time went on, they realised that without involvement in these steps, the watershed groups lacked a sense of ownership of their project and their data.

With support from River Network and other Pennsylvania organisations, they began holding workshops to help groups design their own study. Because reaching consensus on a study design requires the group to hash out differences in goals and priorities, there is a risk that some members may become alienated and drop out. But those who make it through the process emerge with a stronger commitment to work together towards common goals.

The final step, data analysis and interpretation, is usually the most intimidating for volunteers, so for a while ALLARM continued to perform these tasks on behalf of the watershed groups even as they began helping them create their own study designs. This was not successful as the volunteers did not understand the results.

Now they involve the groups in analysing their own data. The scientists still prepare the graphs, but the volunteers have to interpret the results. The scientists act as facilitators, giving participants the background information they need to look at the graphs and identify patterns through time and space.

When volunteers find out for themselves what story their information is telling, they no longer ask the scientists to "do something" with the data. They are ready to make their own case, rather than having to rely on others to define and explain the issues for them.

The ALLARM group felt strongly that the bottom-up approach, in which they train community members to do their own work, leads to a much higher level of understanding and empowerment. Group members may initially be intimidated by their increased decision-making power and time commitments, but volunteers who have struggled with study design and data interpretation are better equipped to identify risks, assess mitigation options, and participate in policy decisions.

The bottom-up approach is also more effective at building a sense of community and an appreciation for the power of organised groups. It gives the volunteers a sense of ownership of the project, and encourages them to become environmental stewards and advocates committed to seeking community unity for action.

However, the benefits of a top-down approach should not be ignored. Some volunteers prefer to work on a "ready made" project rather than investing the time and energy required for community-designed programs. The volunteer monitors are empowered by the strength of their numbers across the country/state, as well as an increased knowledge derived from frequent stream-site visits throughout the year.

Furthermore, the greater degree of institutional control over study design, methods, and data analysis has made possible more robust data that are more acceptable to the scientific community.

Whichever model is used, volunteer monitors collect independent data that can be used to either uphold or challenge public agency and industry data. This opens previously closed doors for meaningful participation by citizens in environmental decision-making. This kind of dialogue leads to the mutual trust that is essential to cooperate efforts to solve environmental problems.

3.1.3 Community-based water monitoring in Alabama and the Philippines

(Deutch B. 2003)

Alabama Water Watch (AWW) began in 1992 with primary funding from USEPA and the Alabama Department of Environmental Management to Auburn University. The goal was to conduct broad-based public education on water issues state-wide and provide training and technical input for volunteer water quality monitoring.

Most AWW participants are from existing groups such as lake associations, environmental clubs, and schools, and are middle-class people with the time and interest to collect data for protecting or restoring their water body. Monitors' concerns often focus on learning about water; saving stream ecosystems; swimming, fishing or other aspects of water recreation; and overall quality of life.

The Philippines Water Watch (PWW) began in 1994 as one project of many in a large Sustainable Agriculture and Natural Resources Management initiative funded by the U.S. Agency for International Development and spanning three continents, with primary sites in the Philippines, Ecuador and Mali. Auburn University was one of several university partners in the initiative. The particular topics of study in each country were selected based on a consensus of community members and scientists, following an extensive appraisal of the biophysical and social aspects of the region.

The water-related research in the Philippines that led to the formation of the PWW was done with representatives of Auburn University and local community members in the mountainous Manupali River watershed of central Mindanao.

Most participants in PWW are local farmers with less than high school education. Their concerns often focus on drinking water quality and public health, particularly the problem of bacterial contamination.

and on soil erosion and sedimentation, which directly affect farmers' livelihoods. Because the Filipino participants are dependent on untreated water from springs, wells and rivers, and in addition many are aware that their environment has degraded substantially in their lifetime, they have a more immediate concern than their counterparts in Alabama. Environmental problems are more obvious and urgent, so the commitment level of the PWW members is high.

The AWW and PWW have interacted and had mutual benefits on several levels. The PWW program was initially modelled on the established AWW approach and methods, with research partners in the Philippines helping to customise techniques for the local situation and translating instructions into local dialects.

But soon the sharing of techniques became a two-way street. Both AWW and PWW volunteers are motivated by knowing that their monitoring techniques are being used in other countries and that they have the same basic goals of protecting and restoring water resources. Ties have been strengthened among Filipino and Alabamian water monitors by international visits for study tours and training, an Environmental Pen Pal program between schools in the Philippines and the USA, and regular exchanges of success stories.

There are presently about 80 active groups (600 active monitors) in AWW who monitor hundreds of sites on a regular basis. They have about seven staff that work full-time (two to three) or part-time with the AWW Programme. Over the last 10 years, about 1 500 sites on more than 500 water bodies have been tested by 180 groups. This information is some of the most extensive and significant for many streams and lakes, and has recently been incorporated into the development of total maximum daily loads and other aspects of remediation. About 40 experienced AWW volunteers have become certified trainers and quality assurance officers who conduct about 90 percent of the 50 to 60 workshops offered each year. The program has stabilised and diversified its funding base, with buy-in from Cooperative Extension and partnerships with several other agencies and organisations. Costs in these projects have been shared by grants from USAID, local governments and non-governmental organisations such as Heifer International and the Christian Children's Fund.

Currently the Alabama budget is approximately $150 000 (approximately one million Rand) from the State and Federal Government (EPA and state regulatory agency), matched in kind at 40% by Auburn University. The value of citizen volunteer hours is also used as match, and this totals about $300 000 per year. Their international projects (Philippines, Thailand and Brazil) have had budgets as high as $50 000, but most are much less now (Deutsch, 2005).

The PWW program now has four active groups on the islands of Mindanao and Bohol. About 20 to 50 people are members of each group, and six to 15 people from each group are the active water monitors. Two to three staff work part-time with the water monitoring groups. Together, they have collected thousands of samples on several streams. This multi-year information documents a clear gradient of declining water quality across four sub-watersheds of the Manupali River, which is related to human population, deforestation, and agricultural development. Contaminated drinking water supplies have been identified and public health risks have been minimised by remediation. PWW volunteers have been active in educating their neighbours in water issues by giving presentations at village meetings and in schools.

Although the PWW has far fewer monitoring groups than AWW, their pioneering effort has attracted local and national attention, with great potential to impact water policy. The data and the process of community-based water monitoring have been incorporated into the Natural Resource Management Plan of the Municipality of Lantapan, Bukidnon. The local government of the Province of Sarangani

initiated a similar water monitoring program in their region. The PWW water data have been used by the Philippine Institute for Development Studies to advise the Congress on the value of community-based water monitoring as it formulates the first Clean Water Act of the Philippines.

In spite of considerable differences in socio-economic status and culture, both AWW and PWW monitors have similar interests in making life better for the next generation. Both value education and community service, enjoy group activities, and have a strong sense of democracy and grassroots efforts. Both groups have surprised their neighbours, water professionals, and government officials with their commitment and the quality of information that may be collected by non-specialists. Their joint work has personalised the slogan "Think globally, act locally".

AWW have been working on a book on Community-Based Water Monitoring that draws on 13 years of experience in six countries that should be available in draft form somewhere in 2005 (Deutsch, 2005).

They are also offering a two-week workshop, May 16 to 27 2005 (and probably again in the next year) for their project partners and other interested persons to learn about their Global Water Watch Network. The following topics and activities are planned for the workshop:

- Administration of water monitoring programmes
- Presentations and discussions about all aspects of Community-Based Water Monitoring
- Certifications in physical, chemical and biological water monitoring
- Training in quality assurance and data management
- Study tours
- Meeting with staff of an Environmental Regulatory Agency
- Meetings with environmental NGOs and environmental education centres

3.1.4 Citizen Science and Delaware Sea Grant

(Farrell J. 2003)

When the Town of South Bethany in coastal Sussex County, Delaware, wanted to know more about the water quality in their extensive system of canals, their Council turned to the University of Delaware Sea Grant Marine Advisory Service for some answers. Sea Grant had already been working with volunteer monitors for three years through their Inland Bay Citizen Monitoring Program, which started in 1991 to collect baseline water quality information on the bays. It was proposed that local residents be trained to collect data for the study. Grant trained a dozen canal-front homeowners who conducted weekly physical and chemical water quality testing over the course of the summer.

Since then, the Inland Bays Citizen Monitoring Program has undertaken a number of small-scale projects, often to investigate questions raised by the volunteers themselves. Currently there are about 30 volunteers in the Citizen Monitoring Programme. They have one full-time Program Coordinator and usually two student interns during their busy summer months. Some of their volunteers are also very active and contribute special talents and skills to the programme (Farrell, 2005).

These special projects are a great way to invigorate monitors whose enthusiasm may be flagging after years of collecting routine baseline data. While their ongoing monitoring has yielded important information used by the state and for setting total maximum daily loads for nutrients, it doesn't produce the same kind of immediate, visible results as the mini-research projects.

The Citizen Monitoring Program's affiliation with the University of Delaware Graduate College of Marine Studies has helped both with the small research projects and with the ongoing routine monitoring. The college has provided the Citizen Monitoring Program with its own laboratory space and access to analytical equipment. They have a direct link to university staff and students, who are

always willing to lend a hand with laboratory work and data analysis or to lead seminars for the volunteers.

The college benefits as well. Having students involved in the monitoring programme helps the college fulfil one of its primary goals: to develop well-rounded marine scientists and managers. The opportunity to work with volunteers provides students with project management experience and outreach skills that open doors with future employers.

There are less tangible benefits. Through their programme, the university has become a steward of the bays, rather than a research institution. At the same time it is believed that the credibility of the programme and data is enhanced because of the university connection.

As the lead partner, Sea Grant provides the Citizen Monitoring Program with staff and administrative support, volunteer training and education, data management and quality assurance, and news media relations. In founding the programme, the people at Sea Grant saw an opportunity to extend their watershed education mission. Instead of having one educator conducting watershed education programmes, they now have 40 volunteers well-versed in their watershed and its problems out in the community educating their families, friends, and neighbours.

The Citizen Monitoring Program is all about connections. None of the institutions has the resources to do all its water quality monitoring alone, and by working together, they have been able to accomplish much more than they would have working alone.

Currently they conduct several complementary monitoring programmes in southern Delaware, USA - basic water quality monitoring (DO, nutrients, salinity, etc.), a Phytoplankton (Harmful Algal Bloom) Program, and a Bacteria Monitoring Program (to support the state recreational water and shellfish programmes). They also conduct applied research and support marine scientists at the University of Delaware and elsewhere (Farrell, 2005).

The budget breakdown looks something like this:

- Program Coordinator (full time)
- Student or two students - summer internships
- Part-time year-round help
- Supplies - for sampling kits
- Laboratory supplies (reagents, expendable supplies)
- Equipment - computers, microscopes, cameras, etc. They share college equipment (autoanalyzer, etc.)
- Laboratory analysis - for nutrients on autoanalyzer
- Travel - local mileage and travel to conferences
- Overheads for the University

Their budget is about $80,000 but they have got by on a lot less (Farrell, 2005).

3.1.5 Cooperative Extension/volunteer monitoring partnerships

(Herron, E. and K. Stepenuck. 2003)

The Cooperative Extension Service, housed in the US Department of Agriculture, had to take practical information generated by land-grant university scientists directly to the people and encourage citizens to adopt better practices in agriculture, home economics, and rural development.

As the society shifted from rural agriculture to more urban and suburban development, the focus of the Extension programmes changed. In 1992, water quality impacts from non-point sources became a priority with the establishment of the Extension National Water Quality Initiative, which initiated the Extension support of volunteer monitoring efforts.

Cooperative Extension is uniquely positioned to carry out volunteer water quality monitoring programmes. Extension has an established framework within communities and is structured to provide the kind of community education and training that is vital to volunteer monitoring efforts.

While Extension volunteer monitoring programmes started for a variety of reasons, one important similarity was found: these programmes are typically community driven. Many began when individuals or groups set out to respond to local water quality problems and discovered that little reliable, long-term data existed for the waterways they were concerned about. In attempting to find good technical advice about monitoring they turned to their neighbourhood Cooperative Extension. They responded by working with local groups to create programmes based on best current science while focusing on specific community resources and needs.

Some Extension programmes were established to help standardise monitoring methods among existing volunteers. The Volunteer Stream Monitoring Partnership was formed to fill a need for more consistency in methods and data management, and a more coordinated use of the data.

The overall success of Cooperative Extension volunteer programmes is due in large part to their grassroots, bottom-up approach. These programmes often become embedded in their communities, as individuals and businesses take personal responsibility for the health of their community's water bodies.

Extension interactions with volunteer monitoring groups take a variety of forms. Extension often plays a lead role, with overall programme coordination provided by Extension staff. Several of their longest running Extension programmes have enjoyed this kind of substantial support from Extension.

Cooperative efforts with state environmental agency programmes are also quite common, with Extension typically providing technical or support staff, and sometimes funding. Sometimes their role is less apparent, with Extension staff providing training assistance, technical consultation, or educational materials.

Regardless of the role played by Extension, Extension-supported programmes are not immune from the challenges faced by most volunteer monitoring programmes – concerns about the critically important elements of stable funding and stable staffing. Because Extension overall is a federally managed programme, changes in national policies or funding priorities can jeopardise locally important projects like volunteer monitoring. Long-term Extension programmes are generally those that have diversified funding sources and programme elements, ensuring programme flexibility while maintaining the core priorities of the local community.

The advantages to stakeholders, to the monitoring programme, and to Extension from Extension involvement with volunteer monitoring are many and varied. First, the community gets answers to their concerns and the ability to respond to problems and protect their resources. In addition, the volunteers gain access to current scientific research and methods, as well as other university resources, which can enable them to expand their monitoring activities and improve the scope and credibility of the data.

The large number of Extension programmes that have elected to sponsor or support volunteer monitoring efforts is a clear indication of how well volunteer monitoring fulfils Extension's three core goals:

- Educating the public. Volunteer monitoring programmes disseminate water quality information broadly in the community through citizen-to-citizen interactions and provide an opportunity for hands-on science education for youth.
- Encouraging citizens to "adopt better practices". Through monitoring, citizens learn how their actions on land affect the quality of surface and groundwater. This leads directly to voluntary adoption of recommended best management practices for water quality protection.
- Bringing university science to the community... and community science to the university. Volunteer monitoring programmes can turn the Extension link between university researchers and citizens into a two-way street. The volunteer monitors benefit from university expertise, and the data they generate can in turn be useful to university scientists – especially since volunteers frequently gather data in areas where few others are monitoring, and often for longer periods of time than most universities or agencies. Applied researchers can especially benefit by targeting their efforts towards locally identified concerns.

In addition, Extension support of volunteer monitoring benefits Extension by:

- Heightening the credibility and visibility of Extension within the community. The value of Extension activities is underscored when government agencies, community groups, or researchers use volunteer data.
- Forging new links between Extension and other organisations. Volunteer monitoring lends itself to collaboration among citizens, educational institutions, private organisations, and governmental agencies.

3.1.6 Participatory research: linking citizens to scientists

(Schloss, J. 2003)

The New Hampshire Lakes Lay Monitoring Program, founded in 1978, was considered by the University of New Hampshire faculty as a way to involve local residents in collecting baseline lake water quality data for detecting long-term trends and locating problem areas. Their original outreach intentions were twofold: to provide unbiased data for informed local watershed management, and to create an opportunity for participants to gain hands-on understanding of water resource concepts and issues.

What they did not anticipate was that their state-wide "army" of volunteer scientists (approximately 500 volunteers) would prove invaluable in advancing applied research important to lake and watershed management decisions.

During the programme they were made aware of the various concerns of the participants about specific lake and watershed conditions. In many cases the research-based knowledge to fully answer their questions was lacking. After consultation with state agencies and researchers, and usually finding that their limited resources would not allow for obtaining the data needed to start answering some very important questions, it was decided to incorporate into the Lakes Lay Monitoring Program a

new participatory research programme to address the concerns of the monitors. This programme includes the approximately 500 volunteers, one full-time laboratory and educational coordinator and two to four students at any one time.

Participatory research is seen as a collaboration that meets a certain set of criteria:

- Community members should be directly involved in the design and implementation of research projects.
- Research processes and outcomes should benefit the local community as well as the scientific community.
- Community members should be part of the analysis and interpretation of the data and should have input into how the results are distributed.
- Productive partnerships between researchers and community members should be encouraged to last beyond the life of the research project.

All their participatory research projects are based on the use of low-tech (and cost-effective) data gathering coupled with high-tech analysis methods. Having a network of trained volunteers outfitted with sampling equipment and located on sites throughout the state allows for exceptional coverage that would be logistically and financially difficult for an agency or research group to duplicate.

The budget breakdown is more or less as follows:
Expenses:

- Full-time laboratory and educational Coordinator ($80 000)
- Students ($10 000)
- Supplies and travel ($10 000)

Income:

- Testing charges to lake associations or towns ($35 000)
- Charitable/foundation support ($7 000)
- Grants/contracts/services ($35 000)
- Federal/state support ($23 000).

Fish condition study

Their earliest experience with the participatory model was their fish condition study. Their volunteers' perceptions were that their fisheries were declining, but they could not be sure that this was in fact occurring. When they approached their state fish and game agency, they were told that only limited data were available due to the sampling effort required.

The state-wide network of volunteers was able to collect data on the health of important warm- and coldwater species on many different types of lakes over a wide geographic area.

Analysis of the data by a postdoctoral student at the university gave them a much better picture of how important fisheries were doing and how they compared from lake to lake, as well as a baseline from which to document future changes.

The fish condition study is only one of numerous participatory research efforts undertaken by the University of New Hampshire and the Lake Lay Monitoring Program. Their participatory projects have led to significant gains in their understanding of their lakes while at the same time bringing great benefits to the university's faculty and students, the volunteers, and their communities. In the future, this type of collaborative research effort is likely to become even more relevant in helping to supply needed information in a cost-effective manner.

3.1.7 Citizens' Volunteer Monitoring Program

(Snyder, 2005)

Snyder coordinates the Citizens' Volunteer Monitoring Program (CVMP) that is located in Pennsylvania's Department of Environmental Protection, which is a state agency. They have two goals in the programme: to help citizens understand their water resources and to show the Department that volunteers can and do provide credible monitoring information which may be useful to the Department. They do not have a set number of volunteers in the programme, but instead provide any citizen volunteer with assistance upon request. There are many grassroots watershed groups in Pennsylvania, and of these, they know of at least 180 volunteer monitoring groups. They do not work with all of the groups so the number of volunteers they service varies. There are also many other non-profit groups, non-governmental organisations and state and federal agencies they work with and partner with to help them meet the needs of the volunteers.

Snyder coordinates the programme and has two permanent staff working with her. Two of them are funded through a non-point source grant from the United States Environmental Protection Agency and the other position is state-funded. Not counting the state position, they receive about $80,000 from the grant to run the actual programme. However, this amount doesn't include the salaries, benefits or travel expenses for the two positions nor does it include the salary, benefits and travel for the state-funded position. The $80,000 covers supplies ($20,000), contracts/lab fees ($50,000) and indirect expenses ($10,000).

Their activities include holding workshops, upon request, for volunteers on topics including water chemistry, macro-invertebrate identification and study designs. They also have a volunteer lake monitoring programme, a volunteer bacteria monitoring programme, and they are developing a volunteer monitoring programme for stream restoration projects (natural stream channel design projects). They work with the various partners mentioned above to meet the needs of the volunteers and are currently working with their partners to help design a state-wide data system for volunteer data. There are 24 Senior Environment Corps across the state that they help by providing guidance and technical assistance. These Corps are composed of senior citizens from senior centres and retired senior volunteer programmes that monitor water chemistry monthly and do macro-invertebrate monitoring and habitat assessments twice a year. They work very closely with the Pennsylvania Organisation for Watersheds and Rivers to do a quarterly newsletter, "Monitoring Matters". More information on the state-wide data system and "Monitoring Matters" can be found at www.pawatersheds.org.

3.1.8 National Level Volunteer Monitoring – Secchi Dip-In

(World Water Monitoring, 2003)

A university/volunteer monitoring partnership of unusually large scope is the Great North American Secchi Dip-In, which is directed by three scientists at Kent State University, with sponsorship by the North American Lake Management Society and the USEPA.

In July 2002, more than 2 500 volunteers from volunteer monitoring programs in the United States and Canada measured transparency in their favourite lake, reservoir, river, or estuary and sent their data to the Dip-In website. The majority used the traditional black-and-white Secchi disk, but a few used an all-black disk and others – particularly those monitoring streams and rivers – used transparency tubes.

Each year, the Dip-In data are displayed on maps that are posted at the website. Lakes in the northern part of the United States and Canada are typically the clearest, while those in agricultural regions of the Midwest tend to have some of the lowest transparencies.

The Dip-In also collects information on the volunteer's perception of water quality, which varies considerably from region to region.

3.2 Australia

3.2.1 Waterwatch in Australia

(Waterwatch Australia, 2003)
In 1992 concerns regarding declining water quality were growing in Australia as visible signs such as rising salinity and blue green algal blooms in their waterways were becoming more prevalent.

In recognition of this growing concern for water quality, the Commonwealth Government initiated Waterwatch in 1993. Waterwatch Australia is a national community water monitoring programme that encourages all Australians to become involved and active in the protection and management of their waterways and catchments. Their vision is healthy waterways.

Since Waterwatch began, the number of monitoring groups has grown from 200 operating in 16 catchments, to nearly 3 000 groups in 200 catchments. Regular monitoring occurs at approximately 5 000 sites nationally. The Waterwatch network is made up of individuals, community groups and school groups who undertake a variety of biological and habitat assessments and physical and chemical tests to build a picture of the health of their waterways and catchments.

The essence of Waterwatch is described in the following beliefs and principles.

- Everything that happens in a catchment can have downstream effects.
- Community participation is vital to ensure effective environmental management.
- Education is a fundamental element of environmental management.
- Shared responsibility and collaborative action through partnerships is effective.
- Monitoring by the community facilitates environmental action.
- Local cultural, historical and environmental knowledge is a valuable resource.
- The causes of environmental degradation should be addressed, not the symptoms.
- Changing attitudes and values will lead to behavioural change.
- Support for on-ground action by communities is essential.

By monitoring their local waterways over time, community members can determine if the health of the waterway and surrounds are improving, declining or being maintained. Waterwatch groups have also initiated many positive solutions to improve the quality of their waterways by areas of riverbanks, eradicating weeds and invasive species, and reducing the use of pesticides and other pollutants.

Funding for Waterwatch is provided by the Federal Government's Natural Heritage Trust and is administered by a team based in the Sustainable Water Section of Environment Australia.

Waterwatch is an "umbrella" scheme, which assists in the coordination of the Waterwatch Program in every State Territory. There are Waterwatch Facilitators for each State Territory and they assist a number of regional coordinators with the running of a variety of local monitoring programmes. The Waterwatch network strives to achieve a shared responsibility and collective action for natural resource management through partnerships between community, government and industry.

Flotsam & Jetsam is a newsletter focusing on coastal issues in Australia. This group also makes use of volunteer monitors and is closely associated with Waterwatch activities, and uses the newsletter as a resource to keep their volunteers informed (Flotsam & Jetsam, 2001).

Streamwatch
(Streamwatch, 1990)
The Streamwatch programme has initiated the idea of inviting school children to participate in monitoring the water quality of rivers and streams in New South Wales. As a result of this programme, the public has become highly aware and more concerned for their environment.

The Streamwatch programme has been a success due to the cooperation and coordination of various stakeholders involved, schools, local communities, social clubs, NGOs, etc. School children and local communities that volunteered in this programme were trained to monitor and gather water samples for the use of water quality assessment in a proper scientific manner. With the help of volunteers, information on the water quality of rivers and streams has become available at a very cheap cost.

An improvement in fresh water quality, and the revitalization of rivers and streams by local communities was the focus of the Streamwatch groups by doing something to improve the condition of rivers and streams that is generally beyond the financial and logistic abilities of most governments in the region.

The Streamwatch programme, initiated by the Sydney Water Corporation, is one of the most innovative and successful water quality projects in the world.

In 1990, Sydney privatised its water supply, changing the Sydney Water Board to the Sydney Water Corporation. They set up a public relations project as a means of reducing the rapidly declining conditions of the watersheds, streams and rivers. They hired a dynamic science teacher, Mr Ramsay, who had been experimenting with the concept of community participation in measuring and restoring water quality in streams.

He organised a special educational team to coordinate a program that would put Streamwatch on the New South Wales primary and secondary school curricula. The students measured water quality in streams and rivers near their schools using a field handbook and water testing kits developed for the project. Testing, analysis and reporting required strict data quality procedures. Innovative testing procedures included a "Bug Detective Kit" that provided a biological index of water quality based on the types of invertebrates found in the stream.

At first, professional water quality personnel at the Sydney Water Board did not accept the data as valid scientific information. The professionals were asked to participate by instructing schools on water quality testing procedures and showing the students, in the field, the correct sampling procedures.

"The transformation was remarkable," said Mr Ramsay, "Before we were spending a lot of money gathering a small amount of data from a limited number of stations that nobody wanted to use. Afterwards, we were spending a little money gathering a huge amount of data from around the whole of New South Wales that everyone was interested in."

Streams and rivers became the focus of the students and their parents, and by extension, the business community. Social organisations, like the Lions Club and Rotary International, helped out by buying water testing kits and supplies for schools. Water sporting clubs, like fishing and kayak clubs, joined in with projects to test and clean up rivers. When students discovered water pollution (as they did) they not only notified the Sydney Water Corporation, they confronted the offenders and demanded that they stop harming their river. Community pressure quickly cut through the complex and expensive legal process.

Every Australian state has followed the Streamwatch example and established volunteer partnerships with community groups. These finally joined together as a national Waterwatch programme that coordinates all of the groups into a network extending from local communities, private corporations and NGOs through state governments to the national and international scene. In 1995, more than 20 000 Australians sampled streams, rivers and lakes around the nation. In one week they produced a coordinated image of the state of the nation's fresh water resources. Data collected by the more than 2 000 volunteer groups are integrated on the Internet.

Many streams and rivers throughout Australia have been cleaned up by community groups following poor water quality measurements.

Waterwatch in South Australia
(Waterwatch South Australia, 2002)
Waterwatch is a national community water monitoring programme in South Australia. It aims to increase knowledge and encourage community education, awareness and involvement in catchment care. It has grown to over 490 schools and community groups monitoring almost 800 sites in seven major catchments. Nearly 13 000 people are involved in Waterwatch monitoring activities and over 32 000 are involved in general Waterwatch SA activities.

People of all ages and from all walks of life are involved in Waterwatch, including individuals, environmental groups, industry groups, community groups, students of all ages, landowners, catchment water management boards and government. By working together to plan a monitoring programme and to obtain monitoring equipment these people can work to help protect their local catchments.

The Waterwatch SA programme is made up of a team of state and regional coordinators who are available to provide community groups and students with ongoing training and education sessions on water monitoring and catchment health. Regional Waterwatch Coordinators enable groups to share their monitoring information with other Waterwatch groups and environmental organisations to assist in protecting and improving the long-term health of their water resources. Regional Waterwatch staff is also available to work with the community to contribute information on the state of their local environment and assist in the evaluation of on-ground projects. Regional Waterwatch people can provide training in assessment of catchment health, equipment use, sampling techniques and data interpretation.

Waterwatch Tasmania
(Cassidy M. 2003)
Waterwatch Tasmania is a part of Waterwatch Australia, a national community water quality monitoring programme funded by the Federal Government's Natural Heritage Trust. As a result of growing participation, the programme has developed into a network of more than 2 000 groups regularly monitoring more than 5 000 sites around Australia.

Waterwatch Australia – Case studies – Community Water Quality Data
(Waterwatch Australia, 2003)
The following stories highlight the types of water quality data that the Waterwatch network collates through water monitoring and how this data is used to assist the community, government and industry in natural resource management.

Waterwatch is an important element in the conservation of waterways. Australia's water systems are threatened by unsustainable levels of water extraction, the destruction of aquatic and riverbank habitat, weed growth, algal blooms and rising levels of salinity, silt and pollutants.

Across Australia, data is collected by monitoring groups using nationally adopted protocols for nine parameters, which include macro invertebrates, dissolved oxygen, temperature, pH, conductivity, reactive phosphorus, nitrogen and riparian habitat assessment. The data is recorded using nationally agreed units and national site code systems.

Once collected, the data is entered into a standard national Waterwatch database. The data can then be pooled, analysed and interpreted for specific catchments or larger regions. This system enables reports to be produced for water management authorities to assist in natural resource management.

The King Island saline groundwater monitoring program

One of the most important roles for Waterwatch groups on King Island is to support the on-going salinity ground water monitoring programme. The programme is part of the Department of Primary Industry, Water and Environment's (DPIWE) Salinity Community Partnerships Program, and involves landowners monitoring the groundwater and salinity levels in specially designed piezometers.

The piezometers have been installed on private properties in salinity hotspots, and each month the land managers are provided with a data sheet where they can fill in their observations for each piezometer. The completed data sheet is then faxed back to the Waterwatch Coordinator who records and analyses the data before forwarding it to the DPIWE Salinity Officers.

The key to the great success of this programme has been the commitment of the particular landowners monitoring the eight piezometers across each of their properties every month. These individuals know the impact that dry land salinity can have on their properties and production, and are keen to assist in collecting sound, quality data to help fully understand the cause, status and scope of the problem on King Island.

The King Island Salinity Community Partnerships Program is taking a catchment-wide, strategic approach in understanding the problem. From the on-going water data these community members collect, the DPIWE and King Island Waterwatch are now able to identify innovative, catchment-specific management approaches for the thousands of hectares affected by dry land salinity on King Island.

Lake Parramatta – Swim towards 2005

Lake Parramatta is a sandstone dam that was a popular local swimming hole in the 1920s. After a housing boom in the upper catchment in the late 1970s, the health of the dam started to suffer. In the late 1980s the Parramatta City Council prohibited swimming in the dam due to concerns about pollution and risks to community health.

From 1998, with the assistance of grant funding from the Commonwealth Government's Natural Heritage Trust, the Upper Parramatta River Catchment Trust coordinated local Waterwatch schools to collect water quality data on the dam. Primary and secondary schools are participating in the testing programmes to establish the health of the dam.

The main problems identified by the students and outlined in the Lake Parramatta Water Quality Management Plan included nutrient rich runoff from surrounding residential areas, sewage pollution after heavy rain, the large number of dumped domestic ducks at the dam, and a lack of awareness about the impacts of local residents on the dam.

Parramatta City Council and the Upper Parramatta River Catchment Trust have adopted a programme of activities to address these problems and achieve water quality in Lake Parramatta by the year 2005 in which the residents can safely swim.

The River People

The Goulburn Broken Catchment Management Authority recognised the need for high rainfall event monitoring along the Tea River. It had regular monthly monitoring results to provide some information, however, they were more interested in data collected after rainfall. Rain increases turbidity by washing soils, nutrients and litter into a waterway. Finding out where exactly these sediment loads come from was seen as essential in order to implement best practice management in the catchment.

Realising that the human resources required to undertake water monitoring activities across the catchment were considerable, the regional Catchment Management Authority turned to Waterwatch for assistance. The Tea River Community Monitoring Group was formed in response to media articles asking for volunteer monitors. Comprising 14 locally based volunteers, the group now monitors at 20 sites.

Initially, members of the group were issued with data sheets and testing equipment. Together they developed a monitoring plan taking into account individual concerns such as turbidity sources, litter dumping and stormwater drains. The Group Coordinator regularly visits all of these sites to take photos, conduct water tests and to ensure equipment is being used correctly to collect accurate data.

Nhulunbuy Primary School Waterwatch Group

The Nhulunbuy Primary School Waterwatch group from Northeast Arnhemland in the Northern Territories had been monitoring the water quality of the Beagle Circuit Creek for a year when they discovered increasing high nitrate and phosphate levels.

After continuing to monitor the site for a couple of weeks and with the results remaining the same they notified the local council. The students, with the local health inspector, tracked up the creek to see if they could find the source of the pollutants. It was found that the evaporative ponds were not working properly and the sewerage pond outlet was emptying into the creek.

At a later stage the students noticed a blue green swirl starting to form on the water that they subsequently sampled and sent to the Water Resources laboratories for analysis. The analysis confirmed that the students had found a thick infestation of blue-green algae.

The local council, in consultation with the Waterwatch Coordinator and Water Resources undertook further monitoring to confirm the group's results. As a result, a large capital works programme was devised to drain the ineffective pond completely and re-route the water to alternative town ponds. Waterwatch data in this instance was directly related to major environmental change in the community.

Talbot Brook Land Management Association

The Talbot Brook Land Management Association has been actively involved in collecting water quality data since its inception in 1994. The catchment lies within the wheat producing region in Western Australia, and like many other areas suffers from rising groundwater and salinity.

The group has a good collection of baseline data and in 1995/96 they were awarded a National Landowner Program grant to look at catchment planning and water table monitoring. The group has been monitoring surface and groundwater quality since 1997 as part of the Water and Rivers

Commission's Avon Community Water Quality Monitoring Program funded through the Natural Heritage Trust.

Funding has been used to set up regular monitoring programmes to look at nutrients, sediment and salinity levels in the Talbot Brook throughout the year. Water quality information collected to date has provided an excellent set of baseline data in which future changes to the water quality of Talbot Brook, its many tributaries and the surrounding catchment can be monitored.

A foreshore and channel assessment of the Talbot Brook was completed in 2001 as part of a Natural Heritage Trust project supported by the Water and Rivers Commission: Management surveys of major tributaries. This data will be combined with water quality monitoring data to provide a greater knowledge base in understanding catchment health and help to prioritise areas for future management.

Communities Monitor Waterways in South Australia's Arid Regions

In 2002, the "Year of the Outback", the contribution of volunteers that monitor South Australia's arid and semi-arid areas was acknowledged. Arid areas have attracted considerable scientific interest for their outstanding natural values. However, monitoring of their aquatic ecosystems has been limited due to the variability in rainfall, unpredictable presence of water and increasing travel time and costs due to their access, especially during flood events.

Volunteer monitoring in South Australia's arid regions significantly adds to the existing scientific knowledge of these areas. In many cases, little or no data exists for aquatic ecosystems, therefore community collected data can be extremely useful in terms of natural resource management for these regions. Through Waterwatch, local stakeholders in the Broughton and Wakefield catchments in the north of South Australia are encouraged to participate in regular Waterwatch monitoring and other events such as Saltwatch, Frog Census and Aquatic Snapshots.

Saltwatch is an environmental monitoring programme that helps Waterwatch groups learn about the effects of salinity on water quality in their catchment. The level of participation in volunteer monitoring and the high standard of the collected data from this semi-arid region highlight the community's commitment to being involved in water quality issues relating to their catchment.

3.3 Canada

3.3.1 Policy Recommendations on Watershed Stewardship

(Langley Environmental Partners Society, 2003)

The National Watershed Stewardship Report provides policy recommendations and actions for expanding and strengthening watershed (catchment) stewardship in Canada.

A process of consultation was followed and the National Watershed Stewardship recommendations were derived through workshops, surveys, and on-line discussions with stewardship groups in five regions. Volunteers and professionals from each region met for a workshop to amalgamate regional results and develop recommendations and actions.

Catchment stewardship focuses on promoting, monitoring, and conserving the ecological health and biodiversity of an area of land that drains waters, through a stream and its tributaries to a shared destination (i.e. a watershed or a catchment). Since catchments often span many jurisdictional boundaries (e.g., of governments, of agencies, and of organisations), effective catchment stewardship requires strong collaboration among communities and all levels of government. Coordinated

governance and integrated decision-making is then needed among environmental, economic, and social interests. Building understanding and partnerships among different communities, improving collaborative and inclusive decision-making, and respecting community rights are all key components of successful catchment stewardship.

An investment into community-based, catchment stewardship can provide the following benefits:

- Effective monitoring of the processes that influence ecosystem integrity. Catchments are the most effective unit to monitor ecosystem integrity because everything within a natural system is inter-connected.
- An economic and effective way of protecting catchments, supporting community activities, and delivering government mandates and programmes. A community-based model of ecosystem management has been shown to be five to 12 times more financially efficient than a direct government delivery approach.
- A long-term, pro-active approach to environmental protection. It is more cost effective and efficient to conserve natural systems than to replicate or restore them.
- Healthier societies where people share information and work together to realise common goals that benefit their catchments and their communities.
- Collaborative governance models able to address complex socio-ecological and technical dilemmas. Catchment stewardship promotes joint target setting, monitoring, and evaluation, leading to strong accountability in achieving shared goals and objectives.
- Improved commitment to international conventions and agreements.

The report describes 22 recommendations with implementation actions for government and communities to expand and strengthen catchment stewardship programmes and activities in Canada. Since catchment stewardship includes all human activities on the landscape, the recommendations are strongly linked to numerous national policies and strategies that are being developed across federal departments, particularly those associated with *Canada's Stewardship Agenda*. The following non-prioritised list identifies the most important actions for implementation:

- Provide sufficient, long-term funding for volunteer and community-based organisations to work with landowners to plan and implement stewardship
- Provide mechanisms for different catchment organisations to coordinate activities, exchange ideas, and share experiences so that programmes are delivered as efficiently and effectively as possible
- Legislate catchment planning and ensure the integration of catchment stewardship programmes into existing policy regulations and activities
- Develop public awareness campaigns aimed at increased understanding of the importance of catchment stewardship
- Commit to building collaborative partnerships with communities, industry (including forestry, agriculture, mining and energy), all levels of government, and community groups
- Develop and support environmentally sound measures that allow landowners to correct ecological problems on their land (e.g. financial and tax incentives, agri-environmental payments)
- Provide the necessary tools to monitor and interpret data, and ensure that the results are used to adaptively manage programme delivery and implementation

Although this report was written for Canada, it is also of significance to all parties and individuals involved with, or having an interest in, catchment stewardship. The recommendations will be of particular interest to those with a mandate to develop or strengthen stewardship programmes within their department or organisation.

3.3.2 Canada's Stewardship Agenda

(Anonymous, 2002)
Stewardship is part of the broader voluntary effort in which Canadians share a commitment to improve the quality of life and to foster vibrant, healthy communities.

Stewardship means Canadians – including landowners and other individual citizens, private companies and volunteers – are caring for their land, air and water, and sustaining the natural processes on which life depends.

Every day, thousands of Canadians at work, home and in their communities take action to improve their natural environment through a variety of stewardship projects – a contribution that is worth millions of dollars. These activities reflect the recognition and importance of a common ethic and means for achieving environmental objectives. Many stewardship initiatives have already been implemented in the forestry, fisheries, oceans, agriculture and wildlife sectors, and others are underway.

In recent years, the Government of Canada and the provinces and territories have committed to further supporting and encouraging stewardship as a key conservation tool. They have consulted with industries, landowners, communities and others about ways to encourage stewardship across Canada.

Canada's Stewardship Agenda is a plan for collaboration that proposes a national vision and operating principles for stewardship. The Agenda outlines four key goals, objectives for each goal and identifies a set of priority actions that recognise and empower stewards.

Stewardship is implemented primarily at the local level, recognising the diverse social and economic conditions across Canada and the different situations faced by stewards in different areas. The following eight principles will guide the implementation of the Agenda:

- Stewardship builds on the strong connection between Canadians and their natural heritage.
- Stewardship initiatives respect the interests and rights of all participants.
- Stewardship is knowledge-based.
- Stewardship is based on ecological principles and ecosystem approaches.
- Stewardship depends on collaborative action, local capacity and ownership.
- Stewardship programmes are developed with an understanding of socio-economic conditions.
- Stewardship programmes are transparent and inclusive.
- Stewardship programmes are ideally based on long-term commitments.

The following four objectives create a framework for engaging Canadians in stewardship at the local, regional and national levels. It is intended to assist stewards in enhancing their efforts and promoting collaborative stewardship activities across Canada.

Objective 1: Invest in stewardship by enhancing stewardship programme support and capacity.

Objective 2: Strengthen the application of knowledge by enhancing participation in stewardship through education and awareness, and by better recognising the contribution of stewards.

Objective 3: Strengthen policy and legislative support for stewards by providing the essential economic, policy and legal tools and instruments required to support stewardship programmes and activities.

Objective 4: Connect stewardship programmes by fostering cooperation among stewardship programmes, and integrating them with terrestrial and aquatic approaches to conservation and sustainable use.

Canada's Stewardship Agenda is a plan for collaboration among Canadians that draws on the collective experience of communities, organisations, the private sector and individuals, and that complement existing stewardship programs. By establishing a broad, long-term course of action and fostering collaborative actions, the Agenda will help guide future investments in stewardship.

3.4 Summary

The following is a summary of success factors, challenges and an indication of some costs involved in volunteer water quality monitoring based on international experience.

- The input from volunteer water quality monitors is of particular value in providing quality data and building stewardship of local waters.

- Volunteers build stewardship of local water. By educating volunteers and the community about the value of local waters, the kinds of pollution threatening them, and how individual and collective actions can help solve specific problems, volunteer monitoring programmes can:
    - Make the connection between catchment health and our individual and collective behaviours
    - Build bridges among various agencies, businesses, and organisations
    - Create a constituency for local waters that promotes personal and community stewardship and cooperation

- Volunteer monitoring programmes can be organised and supported in many different ways. Financial support may come from government grants, partnerships with business, endowments, independent fundraising efforts, corporate donations, membership dues, or a combination of these sources.

- The key is that funding must be available. The people volunteer their time to monitor the water environment, but there are expenses that need to be funded such as sampling equipment and the analysis of samples as well as the coordination and management of these programmes.

  Most volunteer monitoring programmes have concerns about the critically important elements of stable funding and stable staffing. Long-term monitoring programmes are generally those that have diversified funding sources and programme elements, ensuring programme flexibility while maintaining the core priorities of the local community.

  The Illinois Riverwatch is an example of funding sensitivity. The entire programme was dismantled and all 10 staff members laid off by a new Illinois governor looking for places to cut the budget. This programme was 13 years old and was considered a flagship model programme. They had just won an award. This shows how vulnerable volunteer monitoring programmes are when they are dependent upon a state agency for all their funding (Ely, 2005).

  Some funding expenses and figures are illustrated in the following table. The numbers used were obtained from different programmes and should be viewed as indicators of what monitoring involving volunteers costs. From this table it is clear that water quality monitoring is extremely expensive and that volunteers can make a substantial input in terms of man-hours.

Budget elements	Values in $
New Hampshire Lakes Lay Monitoring Program (Regional Programme)	
Expenses: • Full-time laboratory and educational Coordinator • Students • Supplies (sampling kits and laboratory supplies) and travel	 80 000 10 000 10 000 100 000
Income: • Testing charges to lake associations or towns • Charitable/foundation support • Grants/contracts/services • Federal/state support	 35 000 7 000 35 000 23 000 100 000
Alabama Water Watch (State Programme)	
Budget contributors: State and Federal Government Matched in kind at 40% by Auburn University Citizen hours	 150 000 60 000 300 000 510 000

- Many volunteer groups in the USA and Australia collect data that supplements the information collected by state and local resource management and planning agencies. To ensure that its data are used, the monitoring programme should also develop a strong quality assurance project plan that governs how volunteers are trained, how samples are collected and analysed, and how information is stored and disseminated.

  Volunteer groups whose primary purpose is education and constituency-building generally adopt simple, easy-to-use assessment methods and may not need to develop a stringent quality assurance project plan.

- Partnerships are what make volunteer water quality monitoring programmes work. Making it work for both partners begins with talking to potential partners about outcomes, products and "what's in it for them" (Landry, 2004). There are many models for partnerships. Snyder (2004) presents three models:

  Agency/department driven
  Agency projects tend to be rigid, requiring volunteers to follow specific procedures and protocols. The downside of this kind of prescriptive process is that there is no place for volunteer creativity and input into project design. On the other hand, some volunteers like to have a "recipe" to follow, and in addition, volunteers realise that if an agency is asking for help, the data are more likely to be used.

  Combination agency/volunteer driven
  Residents are concerned with the water quality of their river. At the same time an agency is interested in obtaining water quality and other information on the same river. This joint interest can lead to the formation of volunteer monitoring based on a partnership between the agency and the volunteers. The agency provides volunteers with a specific protocol, training, supplies, and equipment on loan, and gives volunteers copies of their monitoring results. The volunteers provide manpower.

Such a project can be a win-win situation for the volunteers and the department. Such a study not only provides the volunteers with information but also provides data that the department can use. The broadening scope of such a project can help volunteers gain an understanding of their river.

Volunteer initiative

The problem with volunteer initiatives is the usability of the data. For data to be usable it must have strict data collection procedures and quality protocols, and often volunteer data do not meet these requirements.

- Citizen projects, including volunteer monitoring, rely on partnerships between citizens and professional scientists. These partnerships can take many forms, which may be arranged along a continuum of increasing community involvement and control. It can be a single-issue, "top-down" programme to a multi-issue, "bottom-up" programme.

  The ALLARM group and the Alabama Water Watch group are examples of the bottom-up approach. The bottom-up approach is more effective at building a sense of community and an appreciation for the power of organised groups. It gives the volunteers a sense of ownership of the project, and encourages them to become environmental stewards and advocates committed to seeking community unity for action. It also leads to a higher level of understanding and empowerment.

  There are also benefits to a top-down approach. Some volunteers prefer to work on a "ready made" project rather than investing the time and energy required for community-designed programmes. Furthermore, the greater degree of institutional control over study design, methods, and data analysis makes possible more robust data that are more acceptable to the scientific community.

  Whichever model is used, volunteer monitors collect independent data that can be used to either uphold or challenge public agency and industry data. This opens previously closed doors for meaningful participation by citizens in environmental decision-making. This kind of dialogue leads to the mutual trust that is essential to cooperative efforts to solve environmental problems.

- Who are volunteer water quality monitors?

  Most Alabama Water Watch participants are from existing groups such as lake associations, environmental clubs, and schools, and are middle-class people with the time and interest to collect data for protecting or restoring their water body. Monitors' concerns often focus on learning about water; saving stream ecosystems; swimming, fishing or other aspects of water recreation; and overall quality of life.

  Most participants in Phillippines Water Watch are local farmers with less than high school education. Their concerns often focus on drinking water quality and public health, particularly the problem of bacterial contamination, and on soil erosion and sedimentation, which directly affect farmers' livelihoods. Because the Filipino participants are dependent on untreated water from springs, wells and rivers, and in addition many are aware that their environment has degraded substantially in their lifetime, they have a more immediate concern than their counterparts in Alabama. Environmental problems are more obvious and urgent, so the commitment level of the PWW members is high.

In spite of considerable differences in socio-economic status and culture, both AWW and PWW monitors have similar interests in making life better for the next generation. Both value education and community service, enjoy group activities, and have a strong sense of democracy and grassroots efforts. Both groups have surprised their neighbours, water professionals, and government officials with their commitment and the quality of information that may be collected by non-specialists. Their joint work has personalised the slogan "Think globally, act locally".

Anybody can be a volunteer as long as there is an interest and a commitment!

- The Citizen Monitoring Program affiliation with a highly regarded academic and research institution, the University of Delaware Graduate College of Marine Studies, has helped, both with the small research projects (citizen science) and with the ongoing routine monitoring. It was found that these small research projects are a great way to invigorate monitors whose enthusiasm may be flagging after years of collecting routine baseline data. While their ongoing monitoring has yielded important information used by the state and for setting total maximum daily loads for nutrients, it doesn't produce the same kind of immediate, visible results as the mini-research projects.

  Having students involved in the monitoring programme helps the college fulfil one of its primary goals: to develop well-rounded marine scientists and managers. The opportunity to work with volunteers provides students with project management experience and outreach skills that open doors with future employers.

  The credibility of the programme and data is also enhanced because of the university connection.

- The New Hampshire Lakes Lay Monitoring Program was considered by the University of New Hampshire faculty as a way to involve local residents in collecting baseline lake water quality data for detecting long-term trends and locating problem areas.

  It is seen as a collaboration that meets a certain set of criteria:
  - Community members should be directly involved in the design and implementation of research projects.
  - Research processes and outcomes should benefit the local community as well as the scientific community.
  - Community members should be part of the analysis and interpretation of the data and should have input into how the results are distributed.
  - Productive partnerships between researchers and community members should be encouraged to last beyond the life of the research project.

  The participatory research projects are based on the use of low-tech (and cost-effective) data gathering coupled with high-tech analysis methods. Having a network of trained volunteers outfitted with sampling equipment and located on sites throughout the project area allows for exceptional coverage that would be logistically and financially difficult for an agency or research group to duplicate.

- The Citizen Monitoring Program is all about connections. None of the institutions has the resources to do all the water quality monitoring alone and by working together, they have been able to accomplish much more than they would have working alone.

- While Extension volunteer monitoring programmes started for a variety of reasons, one important similarity was found: these programmes are typically community driven. The overall success of Cooperative Extension volunteer programmes is due in large part to their grassroots, bottom-up approach. These programmes often become embedded in their communities, as individuals and businesses take personal responsibility for the health of their community's water bodies.

- The advantages to stakeholders, to the monitoring programme, and to university, government department or Extension involvement with volunteer monitoring are many and varied. First, the community gets answers to their concerns and the ability to respond to problems and protect their resources. In addition, the volunteers gain access to current scientific research and methods, as well as other university, government department or Extension resources, which can enable them to expand their monitoring activities and improve the scope and credibility of the data.

- The large number of monitoring programmes that sponsor or support volunteer monitoring efforts is a clear indication to how well volunteer monitoring fulfils certain objectives such as:

    - Educating the public. Volunteer monitoring programmes disseminate water quality information broadly in the community through citizen-to-citizen interactions and provide an opportunity for hands-on science education for youth.
    - Encouraging citizens to "adopt better practices". Through monitoring, citizens learn how their actions on land affect the quality of surface and groundwater. This leads directly to voluntary adoption of recommended best management practices for water quality protection.
    - Bringing university science to the community... and community science to the university.

- Waterwatch Australia is a national community water monitoring programme that encourages all Australians to become involved and active in the protection and management of their waterways and catchments. The Waterwatch network is made up of individuals, community groups and school groups who undertake a variety of biological and habitat assessments and physical and chemical tests to build a picture of the health of their waterways and catchments.

  The Streamwatch programme, initiated by the Sydney Water Corporation, is one of the most innovative and successful water quality projects in the world trying to improve their fresh water quality, revitalising their rivers and streams by local communities. It was a partnership between the communities and the water providing authority.

  The Waterwatch network strives to achieve a shared responsibility and collective action for natural resource management through partnerships between community, government and industry.

- Catchment stewardship, as promoted in Canada, focuses on promoting, monitoring, and conserving the ecological health and biodiversity in a catchment. Since catchments often span many jurisdictional boundaries (e.g. of governments, of agencies, and of organisations), effective catchment stewardship requires strong collaboration among communities and all

levels of government. Building understanding and partnerships among different communities, improving collaborative and inclusive decision-making, and respecting community rights are all key components of successful catchment stewardship.

An investment into community-based, catchment stewardship can provide the following benefits:

- Effective monitoring of the processes that influence ecosystem integrity.
- A community-based model of ecosystem management has been shown to be 5 to 12 times more financially efficient than a direct government delivery approach.
- A long-term, pro-active approach to environmental protection.
- Catchment stewardship promotes joint target setting, monitoring, and evaluation, leading to strong accountability in achieving shared goals and objectives.

The following non-prioritised list identifies the most important actions for implementation:

- Provide sufficient, long-term funding for volunteer and community-based organisations to work with landowners to plan and implement stewardship
- Provide mechanisms for different catchment organisations to coordinate activities, exchange ideas, and share experiences so that programmes are delivered as efficiently and effectively as possible
- Legislate catchment planning and ensure the integration of catchment stewardship programmes into existing policy regulations and activities
- Develop public awareness campaigns aimed at increased understanding of the importance of catchment stewardship
- Commit to building collaborative partnerships with communities, industry (including forestry, agriculture, mining and energy), all levels of government, and community groups
- Develop and support environmentally sound measures that allow landowners to correct ecological problems on their land (e.g. financial and tax incentives, agri-environmental payments)
- Provide the necessary tools to monitor and interpret data, and ensure that the results are used to adaptively manage program delivery and implementation.

Although this list was developed for Canadian catchment stewardship, the same principles will apply in South Africa.

4. REVIEW OF LOCAL EXPERIENCE

The review of local experience was based on literature and interviews with different organisations actively involved in water resource monitoring and management. Other successful non-water related volunteer monitoring models were also included as examples of volunteer monitoring in South Africa.

Raw water is seen as a strategic national resource. Traditionally it has been the responsibility of the Department of Water Affairs and Forestry to manage and protect this resource at all levels. New policy, as discussed in section 1.2, is to devolve this responsibility to the lowest possible level.

There are three tiers of government for water management. The first tier is Central Government; in other words, the Department of Water Affairs and Forestry is responsible for managing the nation's water resources in the public interest and ensuring that all citizens have access to adequate water and sanitation services.

The second tier of government for water management is the responsibility of provincial and regional governments and other authorities. They are responsible for the provision of water, sanitation and other services, specifically through the promotion of effective government structures. Provincial Water Liaison Committees have been established and it is their function to liaise with DWAF, identify priorities and critical areas of need, and to advise on the implementation of the Reconstruction and Development Programme as it relates to water supply and sanitation.

The third tier is that of local government, which will also be discussed.

The following national water quality monitoring programmes are part of Central Government's water management initiatives.

4.1 National monitoring programmes

(http://www.dwaf.gov.za/IWQS)

The National Water Act specifically mandates the Minister of Water Affairs and Forestry to establish national monitoring systems that monitor, record, assess and disseminate information on water resources. To comply with this requirement of the Act and with Chapter 3 of the National Water Resources Strategy, DWAF is developing and implementing a series of national water quality monitoring programmes.

All the data collected from these different monitoring programmes are stored in the Water Management System. The Water Management System (WMS) is a computer program developed specifically for DWAF to support decision-making and to provide the necessary information needed to manage water resources and monitoring in South Africa. The vision of the WMS is to have a working integrated computer system where different directorates and regions, with different mandates and functions, can support each other, sharing information and the workload, and in this way help DWAF to be consistent in all its decisions and actions in the management of water resources.

The following are the current National Monitoring Programmes.

4.1.1 National Microbial Water Quality Monitoring Programme

(http://www.dwaf.gov.za/IWQS/microbio/nmmp.htm)

South Africa does not currently have a central source of information for assessing the potential health risks associated with natural waters contaminated with faecal pollution. With numerous dense settlements (both formal and informal), increasing urbanisation and other factors, South Africa's water resources are coming under increasing threat from faecal contamination.

Because microbes behave in a non-conservative manner in water, a national grid of monitoring sites (like that used for monitoring chemical water quality variables, see section 4.1.3) is both undesirable and impractical.

This programme has the following objectives:

- To provide information on the status and trends of the extent of faecal pollution, in terms of the microbial quality of surface water resources in priority areas
- To provide information to help assess the potential health risk to humans associated with the possible use of faecally polluted water resources

These objectives are primarily national, not regional. It is not the intention that the individual causes and impacts of faecal pollution are identified in this programme.

An implementation manual was written that includes the implementation process and the different monitoring roles from the sampler (in many cases a "volunteer") to the policy maker (DWAF, 2002a).

"Volunteers" are people sampling the NMMP monitoring sites in addition to doing their routine samples. This is not done on a voluntary basis, but is part of their job descriptions.

The design and pilot studies for the NMMP were funded by the Water Research Commission and the Institute for Water Quality Studies at a cost of approximately R1 million. Currently, the programme is coordinated by one full-time National Coordinator and a full-time assistant at about R320 000 per annum. They are also assisted by three part-time Regional Coordinators at a cost of approximately R200 000 per annum. The sampling analysis costs are currently about R400 000 per annum and these are expected to increase to about R1 million at full implementation of the NMMP (Van Niekerk, 2005).

4.1.2 National Eutrophication Monitoring Programme

(http://www.dwaf.gov.za/IWQS/eutrophication/NEMP/default.htm)

Eutrophication is the process of nutrient enrichment of waters that may result in the stimulation of an array of symptomatic changes that are undesirable and interfere with water uses. Eutrophication is of concern because it can have numerous negative impacts. These include ecological impacts (like the deterioration of water quality and the loss of biodiversity), aesthetic, recreational and human health impacts. All these impacts have a significant economic impact.

Many South African impoundments exhibit high nutrient enrichment and eutrophication related problems. Some 80 impoundments have been monitored in South Africa. However, many impoundments do not have regular eutrophication monitoring. A coordinated effort does not exist that allows reporting on the nationwide status and trends of eutrophication.

The aim of the NEMP is to address this need. The NEMP will provide annual assessments of eutrophication in South Africa.

The design of the NEMP was funded by the Water Research Commission over a two-year period at a cost of approximately R600 000. However, the costs will increase annually as the programme expands, starting at approximately R350 000 in the 2003/2004 financial year to approximately R900 000 in 2008/2009. This cost includes only the DWAF budget and does not include the monitoring costs. However, an additional value of about R500 000 per annum is estimated to be required to fully implement and maintain the NEMP (Van Ginkel, 2005). Once again, "volunteers" are used. They are samplers from DWAF regional offices and also samplers from local authorities.

A National Eutrophication Monitoring Programme Implementation Manual (DWAF, 2002b) was developed, and not only provides a national implementation process, but one for regional and local implementation as well. Furthermore, it provides monitoring frameworks for addressing local objectives for impoundments and rivers (except for establishing trophic status).

These monitoring frameworks should be seen as recommended designs for local stakeholders. Because they address more demanding objectives, they necessarily require more intensive monitoring than that required for meeting the national objectives. However, they are intended to provide guidance to local stakeholders on the appropriate design of local monitoring programmes.

These are designs that address their local objectives, and are totally compatible with (indeed, go beyond) the minimum requirements for the NEMP.

This approach is intended to simplify the process of local monitoring programme design and create better buy-in to the NEMP because local objectives are also shown to be important.

However, DWAF will not automatically assume responsibility for such local programmes. This is particularly so if a local design is chosen that goes beyond the minimum requirements for the national programme. Exactly who has what responsibility will be subject to negotiation between DWAF and the local stakeholders. The final decision will then be recorded in a formal contract between the parties. This will also detail who will perform the various monitoring tasks (sampling, analysis, etc.).

A typical idealistic scenario for initialising a local monitoring programme:
DWAF approaches a local stakeholder expressing interest in establishing a local eutrophication monitoring programme in an impoundment in which no such monitoring currently exists. DWAF indicates a willingness to be responsible (i.e. provide resources) to the extent of the minimum national requirements. The local stakeholder examines the recommended local design that meets the chosen local objectives. The local stakeholder agrees to provide the necessary resources for any monitoring that might be over and above the minimum national requirements. Details are negotiated, a contract is drawn up and monitoring starts.

Similarly, any regional monitoring programme that is implemented that addresses regional objectives will also need to be negotiated with the regional stakeholders.

4.1.3 National Chemical Monitoring Programme

(http://www.dwaf.gov.za/IWQS/water_quality/NCMP/NWRQSR.htm)
The National Chemical Monitoring Programme aims to provide regular reporting on the chemical quality of South Africa's surface waters.

A National Water Resource Quality Status Report: Inorganic Chemical Water Quality of Surface Water Resources in SA – The Big Picture, was published in June 2002 (DWAF, 2002c). The aim of this

report is to provide information on the major inorganic chemical water quality constituents of surface waters across South Africa to water resource managers, scientists, decision-makers, and the public. It is intended to provide an overview of the status of surface chemical water quality according to the water quality requirements of two water user sectors, namely, domestic water use and irrigated agricultural water use.

The following recommendations were proposed in the report:

- Revision of the existing monitoring network is necessary to terminate sampling at unnecessary sites and expand the network to cover more adequately the sensitive problem areas or those areas with insufficient sampling sites.
- Role players must be informed of the impact of land uses that result in deterioration in the water quality. This is especially important for mining and agriculture.
- Ways to improve the water quality at those negatively impacted sites must be investigated.
- Water users at sites where the water could be detrimental to their health should be informed to take appropriate precautions. Safe water should be provided to those domestic users who have no access to a safe and healthy water supply.
- Water resources should be protected, in particular the more pristine water sources, in order that their quality does not deteriorate as a result of a change in land use or management practice.
- The trophic status monitoring and assessment programme (NEMP) should be expanded to include more of the impoundments throughout the country and appropriate land use management practices should be encouraged to prevent or minimise large loads of nutrients entering the aquatic environment.

This programme has been ongoing for many years and following the information user-centric approach, it was recognised that water resource management approaches and practices have changed with time. This is confirmed by the above recommendations. Therefore, in order to remain relevant, this monitoring programme is being reviewed to confirm that it still meets its users' information requirements and will be revised if necessary.

The NMMP and NEMP are also planning to publish status reports in future. These can be used as status reports and also to confirm that the national objectives of the monitoring programmes are being met.

4.1.4 *National Toxicity Monitoring Programme*

(http://www.dwaf.gov.za/IWQS/water_quality/ntmp/index.htm)

The objective of the National Toxicity Monitoring Programme is to measure, assess and regularly report on the status and trends of the nature and extent of potentially toxic substances in South African water resources (watercourses, ground waters and estuaries) and the potential for toxic effects to selected organisms in a manner that will support strategic management decisions in the context of fitness for use of those water resources, be mindful of financial and capacity constraints, and yet be scientific.

A report was produced on a needs assessment and development framework for a test implementation plan for the initialisation and execution of a National Toxicants Monitoring Programme (NTMP) (Murray, Slabbert and Moloi, 2003). A few general conclusions were drawn from this work:

- The design of a national toxicants monitoring programme will be complex. The most challenging aspect of the design will be the choice of the most appropriate monitoring variables. There are many potential variables, including individual toxicants, indicators of

toxicant classes, and toxic effects on a variety of potential organisms. Very careful and focused thought will be required to ensure that the stated monitoring objectives are met.

- The nature of the measurement of many of the monitoring variables (toxicity tests and analyses for chemicals like pesticides) is such that it is likely that resource constraints will be a primary factor in limiting the variables chosen for the programme. It has been estimated that this programme could cost up to R10 million per year at full implementation (Kempster, 2005).
- The particular nature of toxicants, their toxic effects and their likely varying behaviour in different water resources (including their sediments), suggests that specialist expertise in these areas will be essential to sound monitoring design. It also suggests that different designs are likely to be necessary for the different water resource types.

4.1.5 South African River Health Programme

(http://www.csir.co.za/rhp/goal.html)

The South African River Health Programme (RHP) primarily makes use of biological monitoring (e.g. fish communities, riparian vegetation, aquatic invertebrate fauna) to assess the condition or health of river systems. The rationale for using biological monitoring is that the integrity of biota inhabiting river ecosystems provides a direct, holistic and integrated measure of the health of the river as a whole.

The goal of the RHP is to serve as a source of information regarding the ecological state of river ecosystems in South Africa, in order to support the rational management of these natural resources.

The objectives of the RHP are to:

- Measure, assess and report on the ecological state of aquatic ecosystems
- Detect and report on spatial and temporal trends in the ecological state of aquatic ecosystems
- Identify and report on emerging problems regarding aquatic ecosystems
- Ensure that all reports provide scientifically and managerially relevant information for national aquatic ecosystem management

The custodians for the RHP are DWAF, the Department of Environment Affairs and Tourism and the Water Research Commission.

A National Coordinating Team (NCT) executes the functions associated with the national coordination required to run the RHP. Their responsibilities include the following:

- Marketing and fund raising
- Day-to-day operations of the RHP at national level as well as DWAF contract management
- Coordination and dissemination of RHP information and products
- Providing a contact point and follow-up mechanism for national and international queries and requests

This project is driven and funded at many different levels, but an indication of the expenditure, including salaries of staff at DWAF HO in Pretoria, and including the consultants they work with, is in the region of R1.5 million per annum, and this grows annually at roughly 5-10%, depending on how many consultants are on board (Madikizela, 2005).

The RHP is one of six programmes, and in total, they cost around R25 million per annum, including salaries and overheads. The most expensive of the projects are the National Toxicity Monitoring Programme and the National Radioactivity Monitoring Programme that is being developed. When fully implemented the Toxicity Programme will cost around R10 million per annum and the Radioactivity Programme around R2-3 million per annum (Kempster, 2005).

4.2 Rand Water

The third tier of government is the local authorities such as the City of Cape Town (see section 4.4) and others that are responsible for bulk water supply (Rand Water and Umgeni Water), the storage of adequate treated water and reticulation of this water to end users.

It seems unlikely that effective local government structures will be established to carry out the responsibilities at the third tier level for some time, especially for the smaller local authorities. Because of this, DWAF has expanded the mandate of the Water Boards, such as Rand Water (this section) and Umgeni Water (section 4.3), to enable them to provide water and sanitation services to the final consumer.

The information on Rand Water and Umgeni Water was obtained from interviews (see section 2.3).

Rand Water has been a bulk water supplier to the Gauteng area since 1903. Their vision is: "to ensure that Rand Water is the industry leader, a socially responsible employer, and the preferred partner and efficient supplier of sustainable water services". More information on Rand Water and their activities can be obtained from their website: www.randwater.co.za.

They have an extensive drinking water quality monitoring programme in place, involving testing water in treatment plants, pipelines and reservoirs within their area of supply. Rand Water supplies this treated and tested water to municipalities, who in turn supply the consumer. They also developed the Tap Analysis Program (TAP). The role of TAP is to provide the consumer and Rand Water with test results for tap water in private homes.

Because of the following concerns, they do not utilize the services of volunteers:

- Logistically it is very difficult to coordinate and get or collect samples, especially in remote areas.
- Volunteers must be reliable (their perception is that volunteers may not be reliable, i.e. won't take the samples regularly, according to the sampling schedules).
- Equipment needs to be supplied, increasing their costs.
- Samples must be delivered to the laboratories on time. (Laboratories run on a strict schedule: if samples are not delivered on time, operations of the laboratory will be affected. This is not so serious for chemistry but very important for microbiological samples.)
- Transport of samples to the laboratories and to the sampling sites especially in the remote areas is problematic.
- Volunteers may need to be remunerated for their transport costs.
- Health and safety of volunteers, especially in remote areas, presents a problem.
- The suggested training requirements, if and when the services of volunteers are to be utilized, should include sampling techniques, field observations and sampling preservation.

4.3 Umgeni Water

The vision for Umgeni Water is to be "the number one water utility in the developing world". More information on Umgeni Water and their activities can be obtained from their website: www.umgeni.co.za.

Their main functions are the following:

- Water management
- Bulk water storage
- Water treatment
- Community upliftment

- Environmental upliftment

They provide the following services:

- Scientific services
- Educational services
- Sanitation

An additional role Umgeni plays is that of monitoring the quality of water from source to sea. The Water Quality Department's sampling officers continuously sample water from around 550 points in dams, rivers, waterworks and wastewater works. The sampling network is continually being increased as the operational area is expanded. The results are analysed in their laboratories and pollution control offices.

Umgeni Water does commercial monitoring and has an established and accredited sampling programme. They are of the opinion that volunteers can be used to perform certain functions with the assumption they receive training in the following areas:

- Techniques for sampling for different purposes (bacterial, chemical and biological)
- Correct containers for different types of samples

Concerns similar to Rand Water's were raised on the potential of using volunteers for water quality monitoring (see section 4.2).

4.4 City of Cape Town

The overall policy of the City of Cape Town is to "provide quality, affordable and sustainable water services in terms of the Water Services Development Plan".

The Peninsula Technikon developed a training programme for volunteers for the City of Cape Town in 1998. For the past few years, the City of Cape Town has implemented *ad hoc* water quality monitoring programmes in different communities. Various problems were identified with the use of volunteers for water quality sampling. The success rate was high when:

- It is need driven, e.g. where a community utilize a resource for recreational purposes
- The programme was an awareness campaign involving school learners.
- The data and information gathered were not used for a specific purpose other than creating awareness.

The following were problems:

- In most instances, no laboratory analysis took place.
- A lack of funding, structure and specific skills within the community resulted in nobody taking responsibility for such programmes.

4.5 Other Volunteer Groups

4.5.1 Volunteer Child Network

A web-based database of organisations active in child abuse prevention and reduction exists. This is a directory of organisations that recruit, train, manage and/or deploy volunteers in the field of child abuse prevention and management of child abuse cases.

A series of seminars involving government, NGOs and civil society was held early in 2002 to identify appropriate ways for ordinary citizens to help prevent, combat and minimise the impact of child abuse. From the result of these seminars, it became apparent that systems were required to identify

appropriate and useful activities for volunteers and to recruit, train and manage volunteers in a sustainable and productive way. The CSIR Crime Prevention Centre subsequently undertook a skills audit and developed this database of organisations involved in the training and utilization of volunteers in the area of child welfare.

This database is the result of a partnership initiative undertaken in close consultation with organisations and individuals.

The objectives of the Volunteer Child Network database are the following:

- This user-friendly database aims to assist volunteers in identifying appropriate roles and directing their support to appropriate organisations involved in various activities related to the prevention of child abuse and minimising the negative impact of child abuse on victims.
- Volunteers will be assisted in offering their services to organisations with requirements closely matching their individual skills and preferences.
- Organisations will be assisted in defining their needs and becoming more accessible to the potential pool of volunteers available in our communities.

Guidelines on becoming a volunteer and making use of volunteers were also developed and are available on their website at www.volunteerchildnetwork.org.za.

4.5.2 St John Ambulance Foundation

The work of the St John Ambulance Foundation is carried out in twelve centres across the country. More than 2 000 uniformed brigade members and several thousand non-uniformed volunteers provide first aid coverage at public events and deliver healthcare services to the community. They are assisted by a network of professionals and trained instructors who give training in first aid and health promotion. They are also working towards a situation where a home carer would be available to each home afflicted with AIDS.

Their mission statement is: "As a leading organisation in the primary healthcare system, we provide, through a caring team of dedicated volunteers and support staff, training and services in first aid, basic health and home care to all in need of our expertise, and to this end we are committed to utilizing our available resources effectively."

Training volunteers is their core business. The St John Ambulance Foundation has a proud tradition of training all levels of the South African community to enable them to assist people in need. The training material complies with the requirements of adult education principles. Volunteers are their greatest asset, and in recognition of this they implemented a development programme for further education and a number of instructors are now studying towards obtaining a qualification as "Education and Training Practitioners." The Foundation is currently working on a plan to present health education in high-risk areas where cholera is prevalent (KwaZulu-Natal). Through this training programme they aim to promote hygiene and correct water use. The organisation also provides courses in basic first aid and AIDS awareness for primary schools learners.

Because of their well-structured training programme, the organisation attracts a diverse group of volunteers, e.g. community members, school learners, matriculants, professionals from different disciplines (accountants, health professionals, business, etc.).

Most of the matriculants or unemployed people perceive the training as an opportunity to secure a job in the formal sector. Even if a person does secure a job opportunity in the formal sector, they maintain their relationship with the organisation as volunteer.

They use the following incentives:

- Volunteers only receive travelling costs when they have to provide a service.
- Certified training courses are offered.
- Uniforms are provided when on duty (first aid volunteers). This gives the volunteer a sense of equal status to the professional paramedics.

The St John Ambulance Foundation has a number of income sources. Most of their funding comes from the private sector as donations. Businesses also contract them for first-aid training for their workers, for which they charge a fee. Their expenses to train one volunteer on Level 1 is R550 and then the volunteer has to pay R50 for the certificate for this particular training course. Level 3 training would cost R800 per volunteer, and the volunteer would have to pay R80 for the certificate.

4.5.3 Catchment fora and rural communities

The following are case studies of volunteer input into different catchment management activities.

1. Rural communities

South Africa is faced with a situation where some 60% of the rural population can be considered as being marginalised in terms of access to both the water resource and decision-making fora. A major challenge is to find effective ways to empower this group so that they have a meaningful voice in the management of the catchment resources on which they and others depend for their livelihoods.

Research into methods for empowering such communities was undertaken by Motteux (2001) in the Kat River Valley, in the Eastern Cape.

The focus was on raising environmental awareness and building capacity to manage the water resource at the local scale of two villages (Fairbairn and Hertzog). By the end of 1998, events had progressed to a point where the desire had been expressed by the villagers to become part of the broader water management structure of the whole catchment.

One outcome of this project was the development of a proposal for a Landcare programme to tackle land degradation, an important factor affecting both land and water quality in the catchment. This programme was implemented after training some of the village people to monitor the land rehabilitation efforts. The research component of the project has been finalised, but the monitoring is ongoing on a voluntary basis in the Okhombe catchment, even though no more funding is currently available (MacKay, 2004).

2. Catchment fora

A. Olifants River Forum

The Olifants River Forum (ORF) is an example of a volunteer organisation that has been running for eleven years.

The objectives of the association are to:

- Encourage and promote the conservation, improvement and sustainable utilization of the Olifants River and its catchment basin.
- Create awareness of the importance of the river as a resource and the impact of various activities on it.
- Encourage voluntary cooperation between interested and affected parties, and to harness expertise, experience and resources to ensure the responsible utilization of the Olifants River and its catchment basin.

- Facilitate consultation and interaction between interested and affected parties, and enable identification and communication of their needs and perspectives.
- Actively promote the involvement of communities in the catchment management activities of the association.
- Develop community leadership capacity so that they can play a meaningful part in the management of the association.

The Olifants River Forum has been established to effectively assist with the protection and the improvement of the ecological systems that depend on the riverine environment within the Olifants River system, in the absence of a Catchment Management Agency. This was eleven years ago, and they are still active. Funding is obtained mainly from membership fees and sponsorships for the day-to-day expenses of the Forum.

Some of their activities include the following:

- They have an annual general meeting where feedback is given on ongoing projects in the catchment.
- They produce one to two newsletters a year.
- They have established a website and produced a pamphlet to introduce the ORF and its activities.
- They have subdivided the area into four regions, Middleveld, Highveld, Lowveld and Mountain regions with different people taking responsibility to champion their region.
- They have an annual Olifants Forum Best Projects Competition.
- They have awareness courses to enhance awareness amongst its members and the public.

There are other catchment forums (i.e. Olifants-Doorn Forum, Vaal River Barrage Forum) and even sub-catchment forums/groups (i.e. Skoon/Koekemoerspruit Forum (part of the Vaal River) and Friends of the Jukskei River) that have been established to create an awareness of issues, such as water pollution and water shortages, in a particular catchment in order to follow a more coordinated and cooperative approach in catchment management in the absence of Catchment Management Authorities.

B. Olifants-Doorn River Forums and Reference Group

There are 19 water management areas in South Africa and the Olifants-Doorn is one. With financial support from DWAF, a series of public meetings was held between February 2001 and August 2001 in the Olifants-Doorn Water Management Area, and eleven catchment forums were established. The purpose of these meetings was to mobilise public participation and to get locals involved in the management of their water resources. During the public participation process, various needs were identified by the volunteers and the forums eventually decided to adopt an integrated approach to solve their problems. A skills audit was conducted to identify the training needs of the volunteers. With the financial support of the Danish Cooperation for Environment and Development (DANCED) a twelve-month accredited training programme was implemented. A specific training programme was developed and the broad basis of this programme is presented in chapter 6 as part of the operational recommendations for the implementation of a volunteer water quality monitoring programme.

All members of the eleven forums (165 members in total) volunteer their time, skills and knowledge without any remuneration. Their inputs are varied and include pollution, conservation and borehole monitoring, as well as involvement and management of specific community projects. The profile of the members includes emerging farmers, commercial farmers, officials from local municipalities, NGOs, conservation, business, tourism and most importantly, local community members (especially mothers) with indigenous knowledge of their water resources.

Through regular meetings, all the catchment forums agreed that a CMA should be established for the water management area. On 28 February 2002, the Olifants-Doorn Catchment Management Agency Reference Group (Reference Group) was formed. Each of the eleven catchment forums nominated six members.

The Reference Group consists of 80 members (66 representatives from the forums and 14 members representing local, provincial and national government).

Since 2002, the Reference Group has had regular meetings every third month. The main purpose of the meetings was to develop an integrated water management strategy and a proposal for the establishment of a Catchment Management Agency. During the process, the Catchment Forums were also encouraged to develop business plans for short-term projects. For example, the Lower Olifants River Forum implemented a water conservation programme and the cleaning of the canal that provides water to emerging farmers in Ebenhezer. Another community project was initiated by the Middle Olifants River Forum where they conducted a survey amongst the residents of Clanwilliam to determine their water use and any leakages. This was also linked to an educational programme whereby the local primary schools were involved.

After four years, most of the volunteers are still involved in the process. The forums are functioning and the Reference Group completed its proposal and is awaiting a response from DWAF.

The comprehensive capacity building and the skills training programme that was implemented contributed towards the sustainability of the Catchment Forums and Reference Group. However, this is an expensive activity, as twenty volunteers were trained over a twelve-month period where they came together every second month for a two-week training course. The costs were R35 000 per week, that included the fees of two trainers, travelling costs, food and accommodation and learning materials. The total amount was approximately R420 000. This cost does not include the development of the training manual.

4.5.4 Threatened Species Project

Another case study where volunteers were used to collect data is the Threatened Species Project. The Greater St Lucia Wetland Park Threatened Species Project (Wetlands Wire, 2004) is a combined effort by Ezemvelo KZN Wildlife and The Wildlands Trust with the support of the Authority, to gain insight into the biology and distribution of threatened species occurring within the boundaries of the Park.

The project is partly sponsored by Unilever, while volunteers from all walks of life are given the opportunity to work in collaboration with scientists to contribute to the conservation of the Greater St Lucia Wetland Park World Heritage Site whilst providing financial support for the fieldwork.

The project aims to update the information about threatened species, conduct rapid field surveys to establish distribution and abundance, as well as detailed studies on a few key flagship species combined with a monitoring programme.

This is a two-year project that will assist the park in evaluating management effectiveness and ensuring that the World Heritage Site is fulfilling its obligation to monitor and protect the threatened species that occur within its boundaries.

This was only one of many such projects where volunteers are used for their research in the Greater St Lucia Wetland Park. What makes this project and others in the Park interesting is that the volunteers actually have to pay for the privilege to help with the research projects. Most of the volunteers are from the United Kingdom. Many of them are gap year students who come to South Africa for a working holiday where they gain experience while holidaying. They stay from two weeks up to five months and pay approximately £1 900 per month for a two-month period (excluding the flight costs of about £800). The shorter the stay (two weeks minimum), the more expensive the visit (www/travellersworldwide.com). Part of this payment goes to the Park for their food and accommodation and the rest to the recruiting agency (Combrink, 2005).

These volunteers are recruited by different agencies, such as the Travellers Worldwide group and the British Trust for Conservation Volunteers. The DaimlerChrysler Working Group also sponsors students to work in the Park.

During the 2003/2004 year, the following volunteers assisted in the project (Combrink, 2004):

- Travellers Worldwide (1-2 months at a time) – 11 volunteers
- British Trust for Conservation Volunteers (2 weeks in September 2003, December 2003, and March 2004) – 26 volunteers
- DaimlerChrysler (Germany) Working Group (1 month) – 16 volunteers

4.5.5 'Friends of' groups

There are many 'Friends of' groups, Silvermine Nature Area, Simon's Town Flora Conservation Group, the Liesbeek, the Cape of Good Hope, the Tygerberg Hills, Lion's Head and Signal Hill, Rietvlei, Groenkloof, Austin Roberts, Rietvlei, Groenkloof, and Nylsvley, to name but a few in the Western Cape and Gauteng. These groups are all linked to the Wildlife and Environment Society of South Africa (WESSA) and their activities and meetings are advertised in the Society's regional newsletters. These groups have volunteers managing the group and organising the outings/tasks, focusing on local problem or sensitive areas.

Their focus is on the environment or specific elements of the environments, such as bird counts or the eradication of exotics in nature reserves. Volunteers participate in these 'Friends of' activities. However, their activities generally do not include routine monitoring, but are more ad hoc activities/tasks.

The focus of these kinds of groups is on local issues. An issue such as a new development or exotic tree species in a nature reserve is identified, and a local person or group of people will then contact WESSA. WESSA will encourage them to form a local interest group and will help in the setting up of a 'Friends of' group. However, this group is managed by a small core of volunteers who are dedicated and motivated by what happens in their environment in the area that they live in or use for recreation (Preen, 2005).

4.5.6 Adopt-a-Beach

The Coastcare Adopt-a-Beach Programme, funded by the Department of Environmental Affairs and Tourism's (DEAT) Marine and Coastal Management Branch, and being implemented by WESSA Western Cape, started in 2004 with about 200 beaches (200 groups) being adopted. There are five coastal regions with 40 groups in each region. The size of the groups varies from a small group of individuals to schools.

The programme is aimed at schools, coastal communities, participants in Coastcare projects like Working for the Coast and Blue Flag beaches, as well as local environmental interest groups. One of

the programme's main aims is to increase knowledge and interest of a particular part of the coast amongst coastal users that will lead to more effective and participative coastal management.

Each participating group was to be provided with a user-friendly handbook (available in four languages) and log sheets, as well as a trommel containing a wide range of items and resource materials useful for monitoring and learning about various coastal issues and having fun on the beach.

A representative from each participating group was required to attend a workshop where the programme was discussed and the resource boxes distributed. A WESSA representative is available to offer support. Involvement in the programme will require on-going monitoring of various beach-related issues throughout the year, as well as communicating with WESSA staff. Reimbursement for travel costs can be arranged in certain cases.

The task remains of keeping the groups motivated, and ensuring that this project is sustainable in the long term. The WESSA regions provide support for their respective Adopt-a-Beach groups throughout the year, and they report back to the two national coordinators for the project.

A bi-monthly newsletter, "Tidal Tales", keeps the groups informed of the different activities and progress over the last two months. There is also e-mail contact with interested parties on the progress of the project (Badenhorst, 2005). This newsletter and the e-mails are used to keep the groups motivated.

None of the data collected are being used. Some of the groups felt that they would have liked the data that they collected to be used for more than an increase in knowledge and interest of a particular part of the coast amongst coastal users (Badenhorst, 2005).

This was a two year project with a total budget of about R3 million over two years. Most of the money was spent on coordination (two national WESSA coordinators) and support (regional WESSA officers) and training (workshops) for the volunteers. The report on the project is due in to DEAT at the end of March 2005. Currently, DEAT have given out a tender for an implementing agency for the next two years.

4.6 Summary

The following is a summary of monitoring programmes in South Africa and case studies from South Africa where the services of volunteers were used.

- Currently there are six national monitoring programmes that have been developed by DWAF, the National Microbial Monitoring Programme, the National Eutrophication Monitoring Programme, the National Toxicity Monitoring Programme, the National Radioactivity Monitoring Programme, the National Chemical Monitoring Programme and the National River Health Programme. These programmes are government-driven and do not use volunteers for any of the water quality sampling.

  What all six of these national programmes have in common is that lots of money was needed to develop (from R600 000 upwards), establish and maintain these programmes (estimated at approximately R25 million per annum currently for all six programmes). This figure would be higher had there not been sampling input from other institutions.

- Rand Water and Umgeni Water, bulk suppliers of water, have extensive water quality monitoring programmes, but also do not make use of volunteers in their water quality monitoring activities. A number of concerns were raised concerning the use of volunteers:
  - Logistically it is very difficult to coordinate and get or collect samples, especially in remote areas.
  - Volunteers must be reliable.
  - Equipment needs to be supplied, increasing their costs.
  - Samples need to be delivered to the laboratories on time.
  - Transport of samples to the laboratories and to the sampling sites especially in the remote areas is problematic.
  - Volunteers may need to be remunerated for their transport costs.
  - Health and safety of the volunteers is a concern, especially in remote areas.

- The City of Cape Town has trained and used volunteer water quality monitors in the past but it was on an *ad hoc* basis and various problems were identified:
  - The success rate is high when it was need driven e.g. where a community utilize a resource for recreational purposes (river), when it was an awareness campaign involving school learners, or when the data and information gathered were not used for a specific purpose other than creating awareness.
  - In most instances, no laboratory analysis took place.
  - A lack of funding, structure and specific skills within the community resulted in nobody taking responsibility for such a programme.

- Catchment fora, such as the Olifants River Forum in Mpumalanga and the Olifants-Doorn River Forums and Reference Group in the Western Cape are active in catchment management and the identification of problem areas (pollution, soil erosion, etc.) in the interim until Catchment Management Authorities are established. Although routine or baseline water quality monitoring is not part of their mandate, problem areas are identified and referred to the local authorities to investigate and solve the problem. Volunteers from the different communities in a particular Water Management Area manage the fora.

- There are a number other volunteer groups such as the 'Friends of' groups. A small core of volunteers who are dedicated and motivated by local issues drives these kinds of groups.

- A current initiative, "Adopt-a-Beach", is aimed at volunteers from schools, coastal communities, participants in Coastcare projects as well as local environmental interest groups. One of the programme's main aims is to increase knowledge and interest of a particular part of the coast amongst coastal users that will lead to more effective and participative coastal management. However, the data that are collected are not being used.

  A bi-monthly newsletter, "Tidal Tales", keeps the groups informed of the different activities and progress over the last two months. There is also e-mail contact with interested parties on the progress of the project. This newsletter and the e-mails are used to keep the groups motivated.

- An interesting concept is where a volunteer has to pay to be part of a project, such as the Threatened Species Project in the Greater St Lucia Wetland Park. British gap year students pay to come to South Africa and to work on research projects during their holidays. They stay anything from two weeks up to two months and sometimes even longer.

- There are a number of very successful non-water related examples of volunteer input, such as the Volunteer Child Network and the St John Ambulance Foundation.

- The main reasons for the success of the Volunteer Child Network are the following:
  - Ordinary citizens help prevent, combat and minimise the impact of child abuse.
  - Appropriate and useful activities for volunteers have been identified.
  - The recruitment, training and management of the volunteers in a sustainable and productive way have been developed.
  - Guidelines on becoming a volunteer and making use of volunteers were also developed.

  The objectives of the Volunteer Child Network database are the following:
  - To assist volunteers in identifying appropriate roles and directing their support to appropriate organisations involved in various activities related to the prevention of child abuse and minimising the negative impact of child abuse on victims.
  - Volunteers will be assisted in offering their services to organisations with requirements closely matching their individual skills and preferences.
  - Organisations will be assisted in defining their needs and becoming more accessible to the potential pool of volunteers available in our communities.

- The St John Ambulance Foundation is assisted by a network of professionals and trained instructors who give training in first aid and health promotion. Training of volunteers is their core business.

  Because of the well-structured training programme, the organisation attracts a diverse group of volunteers, e.g. community members, school learners, matriculants, professionals from different disciplines (accountants, health professionals, business, etc.) to enable them to assist people in need.

  Matriculants or unemployed people perceive the training as an opportunity to secure a job in the formal sector.

  The Foundation uses the following incentives:
  - Volunteers only receive travelling costs when they have to provide a service.
  - Certified training courses are offered.
  - Uniforms are provided when on duty (first aid volunteers). This gives the volunteer a sense of equal status to the professional paramedics.

5. RESULTS AND DISCUSSION

5.1 Questionnaires

This research study was mainly explorative in nature, with the purpose of identifying critical issues relating to the use of volunteers for water quality monitoring. A self-administrated questionnaire was used to collect the empirical data to give effect to the aims of the study. The databases of DWAF and other institutions were used to identify and select key stakeholders (respondents). The information received via the databases was telephonically verified. The questionnaire and information letter was sent out to 1280 key stakeholders. From the mentioned respondents, only 44 completed their questionnaires (Appendix A is a list of the respondents). The following sectors of key stakeholders were identified and selected as research respondents:

- Water Boards
- Irrigation Boards/Water User Associations
- Municipalities:
  - Metro Municipalities
  - District Municipalities
  - Local Municipalities
- Tribal Authorities
- Conservancies
- Catchment Management Forums
- Community Based Organisations
- Wildlife and Environmental Organisations
- Commercial Farmers Associations
- Emerging Farmers Associations

The above-mentioned stakeholders indicate that the selected respondents are a representative group of the research universum (institutional water service providers, managers of water resources and concern groups in the water sector).

The questionnaire was sent out to the mentioned respondents on 29 September 2003 and they were given one month in total to reply.

Research Constraints

- Lack of interest by some of the stakeholders
- Access to and compilation of the database impacted on the timeframe for this phase of the study
- Lack of human resources at community based organisations to assist with the completion of the questionnaire
- Incomplete contact details such as e-mail addresses and fax numbers

The questions and responses to the questions from the questionnaires are presented in Table 1.

Table 1: Questions and responses from the 44 respondents.

QUESTIONS	RESPONSES
1.Does your organisation make use of volunteers to do water monitoring?	Not directly (4) No (36) Yes (4)
2. If your answer to the above question is YES, can you provide us detail regarding their role or responsibilities?	- Monitoring the quality and availability of water in the rural areas - Recording of maintenance timeframes on pumps - Recording water levels of boreholes and reservoirs - Monitoring of salinity
3. If your answer is no to question 1, do you think that volunteers can add value to your company/organisation's monitoring efforts?	- Yes - Volunteers to sample in remote areas - Gather information relating to the status of the water - Reduce risks associated with water quality problems - Volunteers to be utilized as troubleshooters - To report on pollution and water quality issues - Resource protection - An increase in the information base
4. Do you have the capacity within your organisation to fulfil your water quality monitoring functions effectively?	Yes (16) No (13) No comment (15) Some of the respondents clarified their response as follows: - Lack of financial and funding resources - Lack of human capital/resources - Lack of clear legal framework and guidelines - Lack of expertise dealing with water monitoring functions such as microbiologist
5. Can you list any training requirements to develop the capacity of volunteer monitors?	- Laboratory equipment - School Environmental Action Clubs need training - Bio-monitoring materials and training should be given to farmers - Landcare Groups and Conservancies should be primary targets - Awareness of water quality - Sampling techniques - Preservation, storage and transport requirements - Pollution indicators of different water resources - Health risks associated with specific pollution

	substances - Personal safety when collecting samples from different sources - Importance of water quality guidelines, for different sources - How to log and record observations/notes - Administration - Use of SASS tests - Basic Chemical testing - Significance of water quality differences in one catchment - Identification of major polluters - Role of and importance of wetlands - Data collection and processing - Training of volunteers the correct way to read water meters - Recording and Analysis Techniques
6. If your answer to question 4 is No, do you have any plans to supplement your monitoring network by involving volunteers?	Yes (6) No (16) No comment (22)
7. Are you willing to share/transfer your skills through a well-developed training programme with volunteer monitors?	Yes (39) No comment (5)
8. Can you list any constraints that might have an impact by utilizing volunteer monitors?	A list of the constraints: - Consistency and interpretation of results - Lack of in-house resources to manage a formal volunteer monitoring programme - Sample traceability - Contractual impacts - Training - Data capturing - Financial Implications - Reliability of samples - Payment of services rendered - Transport - Continuity - Commitment of the identified person - Availability and reliability - Community pressure - Varying levels of commitment - Travel and cost

	- Coordination of volunteers - Security - Safety - Analysing water samples - Coordination of water sampling logistics - Lack of skills and knowledge
9. Do you think that appropriate guidelines should be developed to ensure effective functioning of volunteer monitors?	Yes (42) No comment (2)
10. Would you like to participate in the development of such guidelines?	Yes (37) No comment (7)
11. Do you think that the utilization of volunteers will lead to greater awareness of the management of water resources in communities?	Yes (38) No comment (6)
12. Do you think that the water forums that were established during the Catchment Management process can be utilized as a resource to provide volunteer monitoring?	Yes (39) No comment (4) No (1), We should provide our own volunteer monitors who are trained and have the correct equipment.
13. Do you feel that the guidelines should take into consideration the cultural and traditional ways of managing water in your community?	- No, it must be scientifically done. - Yes, but we must remember that cultural and traditional ways of managing (using) water is not a licence to impact detrimentally on water quality. - Yes (34) - No (10)
14. Would you like to be kept informed about the progress of the project?	Yes (39) No comment (5)
OTHER COMMENTS	The municipality only monitors the quality of water within its system that means after it has been filtered and chlorinated to ensure that it is safe for human consumption. The monitoring of the water quality within the rivers and canals within the catchment area is the responsibility of the water users association, LORWUA. We are however willing to assist and participate in the setting up of guidelines for the process as it could enhance our own processes.

A brief discussion on the results from the questionnaire is presented below.

5.1.1 Utilization of volunteers for water quality monitoring within existing structures

Relating to questions 1, 2 and 3, the majority response (77%) indicated that most of the organisations do not utilize volunteers for water quality water monitoring. The minority response (23%) provided the following information relating to the roles and responsibilities of volunteers:

- Pollution and bio-monitoring

- Monitoring the water levels of boreholes and reservoirs
- Monitoring the quality and availability of water in rural areas
- Recording of maintenance timeframes on pumps
- Chemical and bacteriological sampling

The respondents are of the opinion that volunteers can add value to the services provided by the institutions.

5.1.2 Capacity of institutions fulfilling their water quality monitoring functions

The response related to question 4 indicated that most of the institutions do not have the capacity to fulfil the above mentioned function effectively.

Furthermore, 50% of the respondents indicated that they do not have any plans in place to supplement their monitoring network through the utilization of volunteers. No reasons were given to substantiate the above response.

5.1.3 Training of volunteers to develop their capacity to fulfil water quality monitoring functions

The majority of respondents indicated that training would be essential. In addition to the identified training requirements, most of the respondents indicated that they are willing to participate in a well developed training programme to transfer their skills and knowledge.

5.1.4 Constraints relating to the utilization of volunteers

In response to question 8, most of the respondents identified a number of constraints (See Table 1).

5.1.5 Development of guidelines to ensure effective functioning of volunteer monitors

In relation to questions 9 and 10, the majority of the respondents indicated that appropriate guidelines should be developed and they furthermore stated their willingness to participate in the process to develop such guidelines.

5.1.6 Utilization of volunteers to create greater awareness of the management of water resources in communities

In response to question 11, the majority of the respondents are of the opinion that the utilization of volunteers will definitely lead to greater awareness of the management of water resources in communities.

In addition to this, the response to question 12 indicated that the utilization of members of the newly established Water Catchment Forums should be considered. Respondents are of the opinion that catchment forum members can play a vital role in the management of water resources in future.

5.1.7 Consideration of cultural and traditional methods of managing water resources

The majority of respondents to question 13 indicated that the cultural and traditional ways of managing water resources in the community must be considered in the development of such guidelines. However, a minority of the respondents indicated that cultural and traditional ways of managing water resources are not a license to impact detrimentally on water quality, and that it should also be scientific.

5.1.8 Continued information sharing relating to the progress of this research project

Most respondents indicated that they wanted to be kept informed of the progress relating to this research project.

5.1.9 Conclusions

Through the process of analyzing the empirical data, it can be concluded that the overall responses were sufficient to make meaningful assumptions. Because of a lack of capacity in the sector, it is clear that there is a need to utilize volunteers to do water quality monitoring. In order to implement the utilization of volunteers effectively, capacity needs to be developed relating to the critical training requirements identified by the stakeholders.

Furthermore, the current skills and knowledge available in the sector can be incorporated in the training process. Before we can give effect to the utilization of volunteers to perform monitoring functions, appropriate and clear guidelines should be developed to assist stakeholders in the guiding and monitoring of the process.

Well-trained volunteers can play a vital role in assisting institutions to perform their functions effectively. The activities in the Olifants-Doorn Water Management Area have shown that by involving volunteers in the management of water resources and exposing them to training, not only the institutions benefit, but communities become more aware of the urgency and importance of protecting our precious water resources.

5.2 Interviews

Interviews with individuals from water institutions

The results from the interviews with Rand Water, Umgeni and the City of Cape Town were presented in chapter 4, sections 4.2, 4.3 and 4.4 respectively.

Interviews with individuals from other volunteer groups

The results from interviews with non-water related volunteer groups were also discussed in chapter 4.

Interviews with individual volunteers

The question "What motivates a volunteer?" was asked to four people who have been involved in volunteer organisations as active volunteers.

Name: Niklaas Mouton
Project: Olifants-Doorn Integrated Water Management Programme
Reason for involvement: "I am involved because I feel that I can contribute towards the protection of our water resources and also make the community aware of their role. I only realized the value of water resources when I was exposed to training. The training that I received was very valuable. I am currently an active member of the Clanwilliam Catchment Management Forum."

Name: Mongezi Mabece
Project: Water purification, Sakhiswe Local Municipality, East London
Reason for involvement: "I obtained a National Diploma in Analytical Chemistry at Border Technikon in East London (2002) and was unsuccessful in finding full-time employment. During the period of February 2004 to September 2004, I was involved in a Water Purification Project at Sakhiswe Local Municipality responsible for testing of chlorine, turbidity, pH, conductivity and oxygen in water. Although it was a short-term project I gained valuable experience and knowledge. I am of the opinion that my volunteer involvement can enhance my career development."

Name: Mary-Ann Adams
Project: First Aid – Stellenbosch Local Municipality
Reason for involvement: "I have been involved with providing first aid services to sport clubs over weekends in Stellenbosch and surrounding areas for the past 14 years. The local municipality is

responsible for providing training. It is accredited training for which we receive certificates. We provide the service weekends during the course of the year. The sport clubs only give us a fee of R150.00 per game for bandages and transport. I have a passion for community service and it gives me a sense of pride to provide this important service. I wanted to become a professional nurse, but due to financial constraints could not fulfil my dream. Volunteer involvement provides me with an opportunity to do what I love most (to be of service to the community)."

Name: Heather MacKay
Project: Lifeline
Reason for involvement: Volunteering at Lifeline after receiving training gave her a sense of community service. There is an immediate reward and a feeling of having helped someone and made a difference.

The responses of all four people indicate that there was a reward in place for each of them. Even though the reasons for volunteering were different for each individual, there was a sense of "I am getting something out of this and at the same time, I am contributing towards society" for all of them.

5.3 Legal, health and safety aspects

Health and safety

The labour law does not provide any protection and benefits for volunteers. It is suggested that labour laws be reviewed to include the working conditions and protection of volunteers, especially their health and safety.

Volunteers in DWAF

Volunteers can be used for sampling if DWAF appoints them. However, there is an issue of authorised access to property. It is possible to "appoint" a volunteer in terms of Article 124 of the NWA. The responsibilities of such a volunteer are stipulated in the letter of appointment and the Regional Director must sign an Appointment Certificate.

The powers and duties of such an authorised person are addressed in the NWA, Article 125.

Data

Any water quality data that were attained legally can be used in court if the person that obtained the data went to the police, made a statement, and is prepared to testify in court. However, it is unlikely that DWAF would go to court with data that was not obtained according to strict guidelines. These guidelines specify how the samples should be taken, handled after sampling and the analysis thereof, as well as the process that should be followed if pollution is being investigated with the purpose of prosecution (Cabin, 2004; Rossouw, 2005). Chapter 3 of the NWA describes these activities (Cabin, 2004).

5.4 Volunteer monitoring workshop

The South African Society of Aquatic Scientists Conference from 5 to 7 July was used as the venue for the informal work session discussing various aspects of volunteer water quality monitoring. A paper, "Guidelines for Volunteer Monitoring", was presented at the Conference, and an informal work session was held on 5 July 2004. Only fifteen people attended the work session of about one hour.

People were contacted telephonically from references obtained during the informal work session. Some of the people that were contacted were Dean Impson (Cape Nature Conservation), Piet Huisenga (retired consultant involved with estuaries), Susan Taljaard and Lara van Niekerk (CSIR), Jacques du Toit (DEA&DP), Alan Boyd (Cape Nature Conservation), Piet-Louis Grundling

(Department of Agriculture), David Klein (Department of Agriculture), Marc de Fonteine (Rand Water), Riana Munnik (DWAF), Dirk van Driel (City of Cape Town) and Ricky Taylor (KZN Wildlife).

However, even though all of these people were contacted, there were no specific projects that used volunteers for water quality monitoring.

The general feeling from the work session was that people were keen to use volunteers on principle, but none have had experience on using volunteers in practice.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The following words of Gladu (2004) summarise aspects of volunteer monitoring: "Given the **enthusiastic** outlook of our volunteers, our emphasis on **quality** data, and our effective **partnerships** with state agencies, municipal governments, and local non-profits, monumental achievements seem possible in the future. With every small success, volunteers are becoming more assured that their efforts are valuable to the community and the catchment. And that is why they became volunteers in the first place".

To measure success exclusively in terms of volunteers making a quantifiable difference in the health of local waters is to overlook the larger impact of volunteer monitoring. It is the unsung successes that really make the difference – the environmental ethic infiltrating the lives of new generations, the sense of ownership and personal responsibility that accompanies the monitoring experience. Stewardship in cities and towns, in rural environments, anywhere where citizens from every walk of life join the common purpose of safeguarding precious resources for future utilization and enjoyment (Hubbel, S, 1999).

The successes of volunteer monitoring are not fully appreciated unless the significance of volunteer monitoring as a democratizing movement that makes a qualitative difference in the lives of volunteers and their communities is recognised. This is the quiet, immeasurable, cumulative impact of volunteer monitoring upon society (Hubbel, S, 1999).

The awareness of the need for a more integrated and coordinated approach to water resource quality monitoring has existed for quite some time. Several years ago, DWAF initiated the definition and development of a comprehensive water resource quality "Monitoring Assessment Information System" (MAIS). Since then, a Strategic Framework for National Water Resource Quality Monitoring Programmes has been developed. However, the use of volunteers to assist with water quality monitoring was not considered in this Strategic Framework.

A strategy or policy framework will need to be developed in South Africa before the implementation of any, especially long-term, volunteer monitoring can even be considered. Institutional conditions must be conducive for volunteers to operate effectively.

6.1.1 Lessons learned

The section on "lessons learned" was initially planned as a separate document, but the authors decided, after consultation with the Research Manager, that it should be included in the conclusions section of this report.

The following are lessons learned from both the international and local case studies. They are not in a particular sequence and are all considered equally important. Should one lesson be ignored in the planning and implementation of a volunteer monitoring programme something can, and probably will, go wrong.

Institutional/governmental support and guidance

- Provide mechanisms for different catchment organisations to coordinate activities, exchange ideas, and share experiences so that programmes are delivered as efficiently and effectively as possible.
- Legislate catchment planning and ensure the integration of catchment management programmes into existing policy regulations and activities.

- Develop public awareness campaigns aimed at increased understanding of the importance of catchment management.
- Commit to building collaborative partnerships with communities, industry (including forestry, agriculture, mining and energy), all levels of government, and community groups.
- The government and other water sector institutions should coordinate to develop a strategy for the use of volunteers in water quality monitoring and set policies for monitoring by volunteers.

Training

Well-trained volunteers can play a vital role in assisting institutions to perform their monitoring functions effectively. By involving volunteers in the management of water resources and exposing them to training, not only do the institutions benefit, but communities become more aware of the urgency and importance of protecting precious water resources.

A well-structured training programme is required. There are many training programmes currently available internationally and locally. A skills audit will identify the specific training requirements of a volunteer group and this must fit in with the objectives of their monitoring goals. Once this is done it is proposed that they tap into the various existing training programmes and select the most appropriate programme that will affectively address their needs. If nothing is available one would have to source funding to develop a specific programme to suit their needs. Furthermore, the current skills and knowledge available in the sector can be incorporated in the training process.

Acceptability of data

Volunteer monitors collect independent data that can be used to either uphold or challenge public agency and industry data. This opens previously closed doors for meaningful participation by citizens in environmental decision-making. This kind of dialogue leads to the mutual trust that is essential to cooperative efforts to solve environmental problems.

It takes time for volunteers to prove themselves to the scientific community or water managers. They have to prove that they are collecting good quality data that can be used for decision-making and not only for awareness campaigns. It takes a mindset change to value the data for what it is – good quality data.

Keep your goals - and those of your volunteers - realistic

Chances are slim that volunteer-collected data will ever be used in court to stop a polluter. Data collected for such regulatory purposes requires a very high degree of quality assurance. Most volunteer data is used to educate the community and to screen for potential problems.

Secure funding

It is critical to secure funding prior to the initiation and implementation of a volunteer project. It is just as critical to have a secure source of funding. It is even better to have multiple secure sources of funding.

Responsibilities towards volunteers

Institutions must be aware of their legal responsibilities towards volunteers, if any exist. If there are no legal protective measures in place, the volunteers should be informed accordingly, before they commit themselves.

Lengthy process

Before volunteers can be used to perform monitoring functions, appropriate and clear guidelines should be developed to assist stakeholders in the initiation and implementation of the process.

It takes time to establish a monitoring programme of any nature. Proper planning is essential. If the use of volunteers is considered, all the structures and funding to initiate the programme should be in place before volunteers are recruited. If everything is not in place, and the time of the volunteers is wasted through action plans not being in place, the volunteers will lose interest and be lost to the programme.

Start small

It is generally recommended that a programme should start small, i.e. with a pilot study, before full implementation of a monitoring project. A pilot project that serves to test out methods, training sessions, and organisational skills can keep you from being overwhelmed and allows you to evaluate and refine your project before moving on to more ambitious efforts.

Commitment of volunteers

Volunteers must be inspired, motivated, keen and caring, to name but a few of the characteristics that will enhance their commitment to a specific volunteer monitoring programme.

The attitude of people plays an important role in their availability to participate in a volunteer monitoring programme.

Education

Education and awareness of environmental issues should start in schools. In this way, a future generation that has an environmentally sensitive attitude will be created.

Public education and awareness programmes are an important component of catchment plans to build support for, and also encourage stakeholder participation in, catchment management.

Make connections

The more people you talk to in your community and within local and state agencies, the more friends and supporters your programme will have. Include potential data users in all phases of your project's development.

Incentives

It does not matter how committed a volunteer is, there must be incentives such as training (enhancing future work opportunities), feedback on work well done, valuable use of the collected data and acknowledgement of their contribution to their communities. Furthermore, the importance of a well-structured and coordinated approach in a volunteer programme cannot be stressed enough.

Training and involvement with a volunteer monitoring initiative also leads to a higher level of understanding of the volunteers' environment and will empower them to be able to contribute towards the solving of an environmental problem. This also serves as an incentive to keep them active in the monitoring programme.

Another incentive is to create an opportunity for volunteer leadership development. Volunteer leaders within a project provide the vision for setting goals and the commitment to achieve them. They also enable a project to develop and grow without stagnating. Build into your monitoring project plenty of opportunities for volunteers to develop as leaders.

Report findings to volunteers and to the community. Help volunteers present monitoring results at conferences and community meetings. Create a newsletter or data report and let the world see what the volunteers have accomplished.

Pamper your volunteers

Volunteers give up their free time to come to meetings, attend training sessions, and travel to monitoring sites. Provide social opportunities and reward volunteers for a job well done.

Short-term versus long-term monitoring

Short-term water quality monitoring that is project-based and community initiated and driven has a better chance of success than long-term ongoing routine monitoring, as long-term monitoring does not produce the same kind of immediate, visible results as smaller projects.

Partnerships

Partnerships are the core of a volunteer water quality monitoring programme. These can be between public and private sectors, between public and government departments/agencies or between public and learning sectors or any combination of these. These partnerships can be based on a number of approaches.

The bottom-up approach is more effective at building a sense of community and an appreciation for the power of organised groups. It gives the volunteers a sense of ownership of the project, and encourages them to become environmental stewards and advocates committed to seeking community unity for action. It also leads to a higher level of understanding and empowerment. The other partner provides the specific protocols, training, supplies, and equipment. The volunteers provide the manpower.

There are also benefits to a top-down approach. Some volunteers prefer to work on a "ready made" project rather than investing the time and energy required for community-designed programs. Furthermore, the greater degree of institutional control over study design, methods, and data analysis has made possible more robust data that are more acceptable to the scientific community.

Coordination

The coordination of a volunteer water quality monitoring programme is crucial to its success. The coordinator is responsible for keeping the volunteers, the funding agency as well as all other partners involved in a specific monitoring programme informed about all aspects of the project.

Don't underestimate volunteers

Never underestimate the capabilities of volunteer monitors. They relish the challenge, but more importantly, they want to collect high quality, usable data because they want their effort to count for something (Fuller, 2004). They should be seen as equal partners in a monitoring programme.

Cultivate data users

One of the fundamental lessons is the importance of engaging data users right from the start. The data needs should guide the selection of the monitoring protocols. Taking the necessary steps to ensure that volunteer-collected data will be used is closely tied to the "don't underestimate volunteers" principle. People who put in time and effort for training and monitoring do not want their commitment treated lightly and they do not want their data treated lightly (Fuller, 2004).

6.1.2 Challenges

Institutional support	- Creating technical support for regional and local structures in developing and implementing water resource quality monitoring plans. - The establishment of a National Monitoring Council to support monitoring activities and provide strategic direction and policies for monitoring in the country.
Funding	Adequate funding is a key component of any resource quality monitoring programme. Monitoring programmes become costly as a result of a need for equipment (both laboratory and field) and other expenses. Operation and maintenance of a monitoring programme, chemicals, the process of information dissemination and training of the monitors are all expenses that need to be provided for before a monitoring programme can be initiated.
Legal issues	The labour law does not provide any protection and benefits for volunteers. It is suggested that labour laws be reviewed to include working conditions and the protection of volunteers, especially their health and safety.
Logistics	Transportation of samples, especially from remote rural areas, can become an obstacle, especially if water samples have to reach a laboratory before a certain time.
Training and capacity building	A variety of skills exist within the Department of Water Affairs and Forestry, other institutions (i.e. Umgeni and Rand Water, SABS and CSIR) and communities. An effort should be make to match the skill with needs of the monitoring programmes. Monitoring programmes must be kept abreast of developments in the Catchment Management Agencies and delegation of monitoring responsibilities over time.

6.2 Recommendations

6.2.1 Starting a volunteer monitoring initiative

A strategy or policy framework will need to be developed in South Africa before the implementation of any, especially long-term, volunteer monitoring can even be considered. Institutional conditions must be conducive for volunteers to operate effectively. This issue was already stated as one of the major challenges facing the use of volunteers for water quality monitoring in South Africa.

Starting out in volunteer monitoring is a major challenge. However, "Guidelines to get started as a volunteer monitor", developed by the USEPA in 1998 and presented in Appendix I, highlights the major issues that should be addressed when initiating a volunteer monitoring activity. Even though it was developed for the USA, the principles are equally valid for South African projects.

6.2.2 Skills development and capacity building

Water resource management will only succeed if skills development and capacity building takes place in all relevant organisations and agencies responsible for water services at all levels.

"If all South Africans are to participate meaningfully in economic and social development as well as their own advancement, they must have general capabilities such as the ability to read and write, to communicate effectively and solve problems in their own homes, communities and in the workplace. But, given the demands of a more complex and changing economy, characterised by increasing use of information, more complex technologies and a general rise in skill requirement of jobs, people must also have rising levels of applied competence.

The focus on skills development is about this process of deepening individuals' specialised capabilities in order that they are able to access incomes through formal sector jobs, through small micro-enterprises or community projects that in turn positively contribute to the economic success and social development of the country. This learning process must also enable people to continue learning and adapting to a constantly changing environment. This is why it becomes important to ensure that all previously disadvantaged groups are given the opportunity for education and career development.

It must be recognised that the level and focus of the capacity building will differ from group to group and even on an individual basis. This specific role, function and responsibilities of individuals or groups combined with existing levels of skill, knowledge and awareness will serve as the basis to determine the type of capacity building that will be required. As well, in many cases the officials and associated participants need to undergo capacity building in order to understand the circumstances, priorities and needs of other participants." (DWAF/UNESCO/WWMO, 2003).

Legal framework

For the purposes of addressing the skills shortage in our country, the government developed the Skills Development Act (No 97 of 1998) Amendment Act of 2003. Although the Act refers to "workers", the principle of skills development also applies to volunteers.

The Minister of Labour, Minister Membathisi Mdladlana, made the following remarks during his budget speech in June 2004 to Parliament: **"Skills development is about changing peoples' lives, about enabling employability and about aligning skills to our economy."**

Views of DWAF towards skills development and capacity building

During 2003, Grobler and Ntsaba were contracted to develop a Strategic Framework for National Water Resource Quality Monitoring programmes and guidelines for such programmes (DWAF, 2004).

The guiding principles of capacity building as proposed by Grobler and Ntsaba (2003) are as follows:

- Ensure that the key stakeholders and priority issues are targeted to meet priority water quality monitoring outcomes of the country.
- Encourage partnerships between stakeholders, especially between responsible institutions.
- Value and build on existing capacity, local expertise and knowledge.
- Capacity building should be based on learning from each other through sharing resources, experience, and expertise, both locally and internationally.
- Capacity building should be based on principles of trust, mutual reciprocity and norms of action (consistency and adherence to agreed upon methods).
- "Learning by doing" and other appropriate learning styles should be used.
- Value and utilize local community expertise and knowledge.
- Capacity building should be accessible to the entire community (general public).
- Capacity building should be based on access to accurate, scientific and technical information.
- Capacity building should contribute to building human and social capital.

They emphasised the following:

The important intermediate outcomes of capacity building relate to:

- Awareness to create attitude, behaviour and practice change through user education.
- Information and knowledge.
- Development of the necessary skills and competencies, institutional support and collaboration.
- Funding.

6.2.3 Skills and capacity building programmes aimed at volunteers

Although initially the following section was seen as a report on its own, the authors, after consultation with the Research Manager, decided to include the skills and capacity building aspects under the recommendations section.

The following will be dealt with in this section:

- The value of volunteer involvement in water quality monitoring programmes
- Guidelines for the training and capacity building of volunteers
- Proposed training areas

The value of volunteer involvement in water quality monitoring programmes

It has been acknowledged that the future of our water resources and the sustainability thereof are dependant on the attitude of the users thereof, and in this instance, the role of community members cannot be ignored or underestimated. It is important that communities are made aware of the significant role they can play to preserve and protect our country's water resources. Any skills development programme must be informed by community participation/consultation of all stakeholders, and the outcomes of a needs analysis of that specific community. As already indicated in this document, volunteers in general have been successfully utilized in different activities and at various levels within communities and sectors (e.g. health, tourism, water conservation programmes.)

Even the NWA emphasises the need for community involvement at all levels within the water sector. It is acknowledged that water resource quality management problems are extremely complex and occur on a broad spatial and temporal scale. The process involves difficult trade-offs between alternative uses and users at local, regional and national level. Individuals within communities, institutions and government require the skills, knowledge and the will to respond effectively to new water resource quality challenges, and adopt an integrated approach in their quest for long-term management solutions. To assist water resource quality managers and users to deal with these complex issues, DWAF, in partnership with other institutions and the private sector, should build on previous initiatives by making further investments through long-term strategic capacity building programmes. The focus should be on addressing all capacity building requirements of water monitoring. By investing in such programmes and promoting the involvement of communities and volunteers, the value and protection of our water resources will become less complex.

6.2.4 Guidelines for the training and capacity building of volunteers

Goals of a training and capacity building programme

According to Dr Dirk Grobler and Mankone Ntsaba, the capacity building programme must address the needs of all of the following functional components of a monitoring programme:

- Data acquisition
- Data storage and management
- Information generation and dissemination

However, these functional components on their own are not sufficient for operating a monitoring programme. They are to be accompanied by the following:

- Design and upgrading of monitoring programmes
- Research and development
- Coordination, communication and collaboration
- Public participation and public relations
- Skills development and training
- Appropriate funding

In summary, the training programme should not only make provision for technical training, but should also include non-technical components such as life skills.

Volunteer recruitment

For the past four years, DWAF has been undertaking a process to mobilise community participation through the Integrated Water Resource Management Programme. Stakeholders and interested parties range from all spheres of Government, NGOs, Water Boards, Water User Associations and Catchment Management Forums. The latter consist of all stakeholders involved on a local level. The broad representation within Catchment Management Forums makes them an ideal tool for the selection of volunteers. It is important that volunteers with the right attitude and a passion for the protection of water resources be involved in monitoring and training programmes on a community level. Local community members often possess valuable indigenous knowledge of water resources in their communities. In most instances, they have developed a good track record of community involvement.

The skills and knowledge of members within Water Boards and Water User Associations should be optimally explored and they must commit themselves to transfer those skills and knowledge to monitoring programmes. In this process, the principle of collaboration and cooperation can be strengthened.

6.2.5 Proposed training areas

Through a process of community participation and consultation with various stakeholders, DWAF, with the financial support of DANCED, developed an integrated training and capacity building programme. Skills and capacity building assessments were done in two water management areas (Olifants-Doorn and Crocodile-Marico) (DWAF/DANCED, 2003).

The training programmes are aligned with the South African Qualification Framework to ensure recognition and certification of participants.

These training programmes are briefly discussed in Appendices B to F for the technical training requirements and Appendices G to H for the non-technical related requirements.

This is one example of existing training programmes. Umgeni and Rand Water, for example, have their own well-structured training units, which are responsible for the development of training materials and presentation of courses.

If a new volunteer monitoring group is established, a needs assessment on their training requirements must be completed. This will depend on the objectives of their monitoring. Once this is done, it is proposed that they tap into the various existing training programmes and select the most appropriate programme that will effectively address their needs. If nothing is available, one would have to source funding to develop a specific programme to suit their needs.

7. REFERENCES

ANONYMOUS, 2002. *Canada's Stewardship Agenda: Naturally Connecting Canadians.* A Federal-Provincial-Territorial Initiative.

CABIN, H. 2004. Department of Water Affairs and Forestry, Legal Services, Personal Communication.

CASSIDY, M. 2003. *Waterwatch Tasmania. Reference Manual. A Guide for community water quality monitoring groups in Tasmania.* Waterwatch Australia.

COMBRINK, X. 2004. *Project Progress Report.* Greater St Lucia Wetland Park. Rare, threatened & endemic species project.

COMBRINK, X. 2005. Greater St Lucia Wetland Park. Personal communication.

CSIR, River Health Programme, 2004, http://www.csir.co.za/rhp/goal.html.

CSIR, Volunteer Child Network, 2004, http://www.volunteerchildnetwork.org.za.

DEUTSCH, B. 2003. Community-based water monitoring in Alabama and the Philippines. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 15(1): Winter 2003.

DEUTSCH, B. 2005, email, 15 March, deutswg@auburn.edu.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2002a. *National Microbial Monitoring Programme for Surface Water. Implementation Manual.* Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2002b. *National Eutrophication Monitoring Programme. Implementation Manual. Final Draft.* South African National Water Quality Monitoring Programme Series. Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2002c. *National Water Resource Quality Status Report: Inorganic Chemical Water Quality of Surface Water Resources in SA – The Big Picture.* First Report. Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2004. *Strategic Framework for National Water Resource Quality Monitoring Programmes by DC Grobler and M Ntsaba.* Report No N/0000/REQ0204. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, Institute for Water Quality Studies, 2004 http://www.dwaf.gov.za/IWQS

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, Institute for Water Quality Studies, 2004 http://www.dwaf.gov.za/IWQS/eutrophication/NEMP/default.htm

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, Institute for Water Quality Studies, 2004 http://www.dwaf.gov.za/IWQS/microbio/nmmp.htm

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, Institute for Water Quality Studies, 2004 http://www.dwaf.gov.za/IWQS/water_quality/NCMP/NWRQSR.htm

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, Institute for Water Quality Studies, 2004 http://www.dwaf.gov.za/IWQS/water_quality/ntmp/index.htm

DWAF/UNESCO/WWMO, 2003. *Mission on the Assessment of Education & Training Needs of the Water Resource Management Services of South Africa*

ELY, E. 2005, email, 26 March,ellieely@earthlink .net.

FARRELL, J. 2003. Citizen Science & Delaware Sea Grant. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 15(1): Winter 2003.

FARRELL, J. 2005, email, 15 March, jfarrell@Udel.Edu.

FLOTSAM & JETSAM, 2001. Coastal Cooperative Research Centres Newsletter (online). Available: http://www.coastal.crc.org.au/newsletters/f_j_november_2001.html.

FULLER, S. 2004. Lessons Learned: Illinois RiverWatch Looks Back. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 16(1): Winter 2004.

GLADU, S. 2004. Maine volunteers partner with regulatory agencies. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 16(1): Winter 2004.

HERRON, E. and K. STEPENUCK. 2003. Cooperative Extension/Volunteer Monitoring Partnerships. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 15(1): Winter 2003.

HUBBEL, S. 1999. Success. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 11(2): Fall 1999.

KEMPSTER, P. 2005. Department of Water Affairs and Forestry: Resources Quality Services. Personal communication.

LANDRY, S. 2004. The Business of Partnering. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 16(2): Summer 2004.

LANGLEY ENVIRONMENTAL PARTNERS SOCIETY. 2003. *National Watershed Stewardship Report: Policy recommendations and suggested actions to expand and strengthen watershed stewardship in Canada.*

MACKAY, H. 2004. Water Research Commission. Personal communication.

MOTTEUX, N. 2001. *The development and co-ordination of catchment for a through the* empowerment of rural communities. WRC Report No 1014/1/01.

MURRAY, K., L. SLABBERT and B. MOLOI. 2003. *Needs assessment and development framework for a test implementation plan for the initialization and execution of a National Toxicants Monitoring Programme (NTMP). Final Report.* National Toxicants Monitoring Programme.

NATIONAL WATER ACT, 1998. Act 36 of 1998.

OLIFANTS RIVER FORUM. 1999. *Constitution of the Olifants River Forum.* Version 4, March 1999.

PREEN, M. 2005. WESSA. Personal communication.

ROSSOUW, J. 2005. email, 18 March, jrossouw@dwaf.gov.za.

SADC, IUCN and SARDC, 1996. *Water in Southern Africa.* Print Holdings, Harare, Zimbabwe. Chapters 1 and 6. ISBN 0-7974-1672-2.

SCHLOSS, J. 2003. Participatory Research: Linking citizens to scientists. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 15(1): Winter 2003.

SCHLOSS, J. 2005. email, 16 March, jeff.schloss@unh.edu.

SNYDER, C. 2004. Pennsylvania Partnerships: Three Models. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 16(1): Winter 2004.

SNYDER, C. 2005. email, 18 March, chesnyder@state.pa.us.

STREAMWATCH. 1990. Waterwatch in Australia (ESCAP Virtual Conference (online)). Available: http://www.unescap.org/drpad/uc/conference/bg_au_1567_str.htm.

TRAVELLERS WORLDWIDE. 2005. www/travellersworldwide.com.

USEPA. 1998. *Monitoring and assessing water quality. Starting out in volunteer monitoring* (online). Available: http://www.epa.gov/owow/monitoring/volunteer/startmon.htm.

VAN GINKEL, C. 2005. email, 17 March, VginkelC@dwaf.gov.za.

VANNIEKERK, H. 2005. email, 18 March, VniekerkH@dwaf.gov.za.

WATERWATCH AUSTRALIA. 2003. *Welcome to Waterwatch Australia. Environmental Action through community monitoring (online).* Available: http://www.waterwatch.org.au/welcome.html.

WATERWATCH AUSTRALIA. 2003. *Community Water Quality Data (online).* Available: http://www.waterwatch.org.au/library/data.html.

WATERWATCH SOUTH AUSTRALIA. 2002. *Waterwatch in South Australia (online).* Available: http://www.sa.waterwatch.org.au/what_is.htm.

WETLAND AUTHORITY. 2004. Wetlands Wire, Volume 2, No 1. Official newsletter of the Greater St Lucia Wetland Park Authority, St Lucia.

WILDERMAN,C., A. BARRON and L. IMGRUND. 2003. The ALLARM Program. Growth, change and lessons learned. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Vol 15(1): Winter 2003.

WORLD WATER MONITORING. 2003. National Level Volunteer Monitoring – Secchi Dip-In. *The Volunteer Monitor. The National Newsletter of Volunteer Water Quality Monitoring.* Volume 15(1): Winter 2003.

APPENDIX A: A LIST OF THE RESPONDENTS TO THE QUESTIONNAIRES

No.	NAME	ORGANISATION	CONTACT DETAILS
1	Marina Kruger: Operations Manager	Midvaal Water Company	Tel: 018 482 1241/50 Fax: 018 482 1241/50
2	Mr A.Said: Director: Regional Planning and Infrastructure Development	West Rand District Municipality	Tel: 011 411 5117 Fax: 011 411 3663
3	A.P.A Tanner: Water Authority Manager	Ugu District Municipality	Tel: 039 688 5766 Fax: 039 6822071
4	Derek Hazelton: Manager	TSE Water Services cc	
5	A.P.F. van Schalkwyk: Munisipale Bestuurder	Kareeberg Munisipaliteit	Tel: 053 3823012 Fax: 053 3823142
6	Dirk van Driel: Manager: Hydrobiology	City of Cape Town	Tel: 021 6481023 Fax: 021 6385083
7	Tony Bailey: Laboratory Manager	Ethekwini Municipality Water and Sanitation	Tel: 031 302 4793 Fax: 031 3024747
8	David Raymer: Water Engineer	Nelson Mandela Metropolitan Municipality	Tel: 041 506 2911 Fax: 041 585 8708
9	G.E. van Zyl: Snr. Omgewingsgesondheidsbeampte	Sentraal Karoo Distriksmunisipaliteit	Tel: 023 449 1000 Fax: 023 415 1253
10	Trevor Roy Groenewald: Superintendent Purification	Ugu District Municipality	Tel: 039 685 4775 Fax: 039 682 4598
11	Charles Rall: Project Engineer	Municipal Mentoring Project	Tel: 040 636 4800 Fax: 040 639 1957
12	Louis van Oudtshoorn: General Manager : Technical Services	Bloem Water	Tel: 051 422 5351 Fax: 051 422 5333
13	H. Masehele: Manager Municipal Works	Nkomazi Local Municipality	Tel: 013 790 1189 Fax: 013 790 1476
14	W.K. Hartzenberg: Head Technical Services	Kannaland Municipality	Tel: 028 551 1023 Fax: 028 551 1766
15	Johan Goosen : Environmental Health Practitioner	PAW – Department of Health West Coast/Winelands Region (Vredendal)	Tel: 027 213 4070 Fax: 027 213 3145
16	Patrick Dowling	Wildlife and Environmental Society of South Africa	Tel: 021-7011397 Fax: 021-7011399
17	Harriet van Schalkwyk: Environmental Coordinator	Black Mountain: A Division of Anglo Operations Limited on behalf of Pelladrift Water Board	Tel: 054 983 9216 Fax: 054 983 2382
18	J.D. Kirsten	Noord Agter Paarl Irrigation Board	Tel: 021 872 7021 Fax: 021 872 4075
19	W.R. Patterson: Director Infrastructural Development	Ndlambe Municipality	Tel: 046 624 1140 Fax: 046 624 2669
20	R. Staphylton-Smith: Chairman	Mzalanyoni Irrigation board	Tel: 039 831 8413 Fax: 039 831 8413
21	Francois Nel: Ass. Director: Environmental Health	Chris Hani District Municipality	Tel: 045 808 4600 Fax: 045 839 3469 Cell: 082 490 8302

22	D. Simpson: Snr. Scientist	Umgeni Water	Tel: 033 411 3320 Fax: 033 341 1349
23	G. Du Toit: Sekretaris	Klaas Voogas Watergebruikersvereniging	Tel: 023 626 1190 Fax: 023 628 4680
24	Albert Nel	Loeriesfontein Opkomende Boerevereniging	Tel: 027 662 1108 Fax: 027 662 1106 Cell: 073 3834226
25	Piet Naude	Free State Agricultural Water Commission	Tel: 051 447 7671 Fax: 058 3031346
26	Danie Bosch: CEO	Groenland Irrigation Board	Tel: 021 848 9755 Fax: 021 848 9752
27	Wayne Ferreira: Water Manager	Perdeberg Besproeiingsraad en Bo-Bergrivier Hoof besproeiingsraad	Tel: 082 7700321 Fax: 021 869 8645
28	Mrs. J. Dixon: Wolwe Rivier Representative	Wilderness Lakes Management Forum	Tel: 044 883 1015 Fax: 044 883 1015
29	Noel C. Pope - Chairman	Buffelspoort Valley Conservancy (BVC)	Tel: 014 574 3612 Fax: 014 574 3612
30	Lynn Archer	Environmental Planner	Tel: 033 341 1345 Fax: 033 341 1218
31	C.M. van der Merwe	Liebenberg – Vlei Forum	Tel: 058 303 8894 Fax: 058 303 8894
32	Mpho Chokolo: Senior Laboratory Technician	Lepelle Northern Water (Phalaborwa)	Tel: 015 781 6821 Fax: 015 781 6144
33	Raymond Auerbach: Director	Rainman Landcare Foundation	Tel: 031 783 4412 Fax: 031 783 4641
34	Dean O'Niel	Matzikama Municipality	Tel: 027 2131045 Fax: 027 2133238
35	Tersia Liddell	Anonymous	
36	Maitland Seaman	Centre for Environmental Management	Tel: 051 401 2629 Fax: 051 401 2958
37	C.J. Francis		
38	M.C. Botha	Metsimholo Municipality Sasolburg	Tel: 016 9760029 Fax: 016 976 3878
39	Bendle	Anonymous	
40	Anonymous		
41	WD Bourbon	Bergriver Irrigation Board	Tel: 021- 8632632
42	Capricorn District Municipality		Tel: 011 529 52888
43		Korente River Irrigation Board, Riversdal	Tel: 028 7133433-
44	Gerrit Korneluis	Sasol Synfuds (Pty) Ltd	Tel: 017 610 2727 Fax: 017 610 4090

APPENDIX B: THE PROPOSED TRAINING MODULE TO COLLECT AND INTERPRET DATA

The following is the proposed training module to collect and interpret data as developed by the DWAF/DANCED project in 2003.

PURPOSE

A qualifying learner will be able to collect, record and interpret data. The competence will provide accurate information to stakeholders within the water sector. This will facilitate water, sanitation and primary health development planning for communities.

Specific outcome 1: Explain data collection

Assessment criteria

- The request and purpose of data collection is explained.
- The type of data required is explained.
- Sources of current data are explained.
- The area of data collection of data collection is explained.
- The amount of data to be collected is explained.
- The methods of collection and recording are explained.

Specific outcome 2: Plan data collection

Assessment criteria

- The protocol for data collection is explained and demonstrated.
- Community members are informed of data collection and the purpose of data collection.
- Dates and routes for data collection are planned.

Specific outcome 3: Collect and record data

Assessment criteria

- Data is collected in accordance with the plan.
- Data is recorded accurately.
- Deviations from plan are explained.

Specific outcome 4: Collate and interpret data

Assessment criteria

- Data is collated.
- Results from data collection are interpreted.
- Conclusions are drawn from data results.
- Results, conclusions and recommendations are documented in a report.

Specific outcome 5: Submit report to relevant stakeholders

Assessment criteria

- Report is submitted to relevant stakeholders.
- Report is submitted within the agreed timeframes.
- Feedback is given to community members.

Specific outcome 6: Complete administration

Assessment criteria

- Reports are filed.
- Administration is complete and up to date.

Assessment options

Learners are assessed through the following methods:

- Oral or written questions
- Observation
- Product sampling reports

Embedded knowledge - learners should have a knowledge and understanding of:

- Alternative ways of recording data
- Alternative ways of communicating data collection and the purpose of the survey to the community
- The importance of keeping data and reports
- The importance of accurate data
- Methods of interpreting data
- Report writing
- Different methodologies of data collection

APPENDIX C: THE PROPOSED TRAINING MODULE TO DEMONSTRATE CHEMICAL AND BACTERIOLOGICAL SAMPLING TECHNIQUES AND FIELD TESTS

The following is the proposed training module to demonstrate chemical and bacteriological sampling techniques and field tests as developed by the DWAF/DANCED project in 2003.

PURPOSE:
The qualifying learner will be able to take representative samples of water and wastewater and carry out field tests, interpret data and document it onto a collection list. This will ensure that water resources are accurately monitored in terms of water quality.

Specific outcome 1: Wear appropriate personal protective clothing in accordance with legislation, work policies and procedures
Assessment criteria

- Personal protective equipment is worn as required.
- Damaged personal protective equipment is reported and corrective action is explained.

Specific outcome 2: Prepare sample bottles and sampling equipment in accordance with work policies and procedures
Assessment criteria

- Different sampling bottles are identified and uses are explained.
- Cleaning and sterilisation procedures for different sampling bottles are explained.
- Correct sampling equipment is collected and checked.
- Damaged sampling equipment is reported and corrective action is explained.

Specific outcome 3: Take chemical samples in accordance with standard methods
Assessment criteria

- Chemical sampling techniques are described and demonstrated.
- The use of the intermediate sample scoop is demonstrated.
- Rinsing of final sample contained with sample liquid is demonstrated prior to final sampling being taken.
- Instances when final sample would not be rinsed are explained.

Specific outcome 4: Take bacteriological samples in accordance with standard methods
Assessment criteria

- Bacteriological sampling techniques are described and demonstrated.

Specific outcome 5: Carry out field test
Assessment criteria

- Field tests are demonstrated.
- Field test equipment is used in accordance work policies and procedures.

Specific outcome 6: Explain the collection of samples from auto-samplers
Assessment criteria

- Methods for collecting samples from auto-samplers are described.
- Irregularities that may be found are explained and the reporting procedure is described.

Specific outcome 7: Hand over of samples to responsible persons in accordance with work policies and procedures

Assessment criteria

- Procedures for hand over of samples to the responsible person are demonstrated
- Relevant reports are handed over to responsible person
- Irregularities encountered during sampling round are reported

Assessment options

Learners will be assessed through the following methods:

- Oral/written questions
- Observation
- Product sample reports, logbooks, test results

Embedded knowledge - Learners should have knowledge and understanding of:

- Basic water and wastewater microbiology
- Basic water and wastewater chemistry
- Different sampling techniques
- Different sampling localities
- Knowledge of the importance of sterilisation techniques in bacteriological sampling
- Sample storage and transportation
- Basic water quality principles

APPENDIX D: THE PROPOSED TRAINING MODULE TO DEMONSTRATE KNOWLEDGE OF WATER USERS AND WATER USERS' NEEDS

The following is the proposed training module to demonstrate knowledge of water users and water users' needs as developed by the DWAF/DANCED project in 2003.

PURPOSE

The qualifying learner will be able to identify water uses, water users and water resources within a catchment and explain their needs and requirements. This will enable learners to advise community members on the use of water resources. This will also contribute to the sustainable use of water resources and an improved understanding of different water users' needs.

Specific outcome 1: Identify different water uses in terms of the National Water Act
Assessment criteria

- Water uses are identified and explained.
- Legal requirements for identified water uses.
- Water uses relevant in own area are explained.

Specific outcome 2: Identify users in own area
Assessment criteria

- Water users are identified.
- Other relevant stakeholders are identified.
- Water needs are identified.

Specific outcome 3: Identify available water resources in own area
Assessment criteria

- Available water resources are identified.
- Status of water resources are explained.
- Water resource data is interpreted and explained.

Specific outcome 4: Identify water-related conflict
Assessment criteria

- Conflicting water users are identified
- Possible solutions are explained

Assessment options
Learners will be assessed through the following methods:

- Oral and written questions
- Simulation

Concepts:

- Legislation - National Water Act (1998)
- Status of water resources - quality and quantity

Embedded knowledge - Learners should have knowledge and understanding of:

- Relevant sections of the National Water Act (1998)
- The rights of water users
- Water uses
- The concepts of allocations and authorisations

- Simple water balance
- The importance of resolving conflict

APPENDIX E: THE PROPOSED TRAINING MODULE TO DEMONSTRATE KNOWLEDGE OF ENVIRONMENTAL HEALTH

The following is the proposed training module to demonstrate knowledge of environmental health as developed by the DWAF/DANCED project in 2003.

PURPOSE

The qualifying learner will be able to explain environmental health to community members. This competence will enable the learner to facilitate health awareness and contribute towards improved environmental health within communities.

Specific outcome 1: Explain environmental health

Assessment criteria

- The definition of environmental health is explained.
- The link between health, sanitation, poor water quality and disease is explained.
- The impact of current community practices on the sustainability of future resources is explained.

Specific outcome 2: Explain relevant water and sanitation related diseases

Assessment criteria

- Water related disease classifications are explained and classified.
- The transmission routes of water borne, water scarce, water related insect vector diseases are explained.
- Transmission routes of water based diseases are explained.
- Faecal oral transmission route is explained.

Specific outcome 3: Describe ways to prevent water and sanitation related disease transmission

Assessment criteria

- Ways to prevent water borne, water scarce, water related insect vector diseases are explained.
- Ways to prevent water based diseases are explained.

Specific outcome 4: Explain appropriate action when community members have contracted water related diseases

Assessment criteria

- The symptoms of water and sanitation related diseases common to own area are explained.
- Remedial action for each water related disease is explained.
- Oral dehydration process is explained and demonstrated.

Assessment options

Learners will be assessed through the following methods:

- Oral and written questions
- Simulation

Concepts

- Terminology

- Water related disease classifications – water insect vector transmission, water borne, water scarce/water washed and water based
- Water related diseases – cholera, diarrhoea, malaria, scabies, conjunctivitis, bilharzias and worms

Embedded knowledge – Learners should have knowledge and understanding of:

- Ways to prevent faecal oral and transmission of diseases
- Instances when oral dehydration would be appropriate
- The importance of good hygiene practices
- The impact of uncontrolled solid waste on the environment

APPENDIX F: THE PROPOSED TRAINING MODULE TO DEMONSTRATE KNOWLEDGE OF THE WATER CYCLE, WATER AND WASTEWATER SYSTEMS

The following is the proposed training module to demonstrate knowledge of the water cycle, water and wastewater systems as developed by the DWAF/DANCED project in 2003.

PURPOSE

The qualifying learner will be able to explain the elements of the water cycle and water catchment management. This competence will enable the learner to value water as a scarce resource and share this knowledge to improve community understanding of the importance of conserving water resources.

Specific outcome 1: Identify and explain the elements of the natural water cycle

Assessment criteria

- The water cycle is drawn.
- All elements of the water cycle are identified and explained.
- Relationship of elements to each other are explained.

Specific outcome 2: Explain the principles of water catchment

Assessment criteria

- Water flow in a catchment is explained.
- Recognised water uses within a catchment are explained.
- Recognised impacts from water uses are explained.
- The economic importance of water is explained.
- Ways to conserve water are explained.
- The principles of charging for water and wastewater treatment and water distribution are explained.

Specific outcome 3: Explain the concepts of groundwater collection and extraction

Assessment criteria

- The principles of groundwater and its role in the water cycle are explained.
- Groundwater trapped in aquifers, fractures and sand is identified and explained.
- Groundwater collection and extraction is explained.
- Principles of resource management of boreholes are explained.

Specific outcome 4: Concepts of surface water collection and abstraction

Assessment criteria

- The flow of surface water and its role in the water cycle is explained.
- Surface water collection and extraction is explained.
- Principles of resource management of surface water are explained.

Specific outcome 5: Identify possible sources of pollution of water and explain appropriate corrective action

Assessment criteria

- Sources of pollution of groundwater are identified and corrective action is explained.
- Ways to prevent contamination of boreholes are explained.
- Self-purification of rivers and streams is explained.
- The role of the water process operator in preventing the contamination of water resources is explained.

Specific Outcome 6: The importance of legislation within the water sector

Assessment criteria

- Relevant national water legislation and licensing are identified and the purposes are explained.
- Relevant environmental legislation is identified and the purposes are explained.
- The purpose of municipal by-laws is explained.

Assessment options

Learners will be assessed through the following methods:

- Oral and written questions
- Elements of water cycle
- Water catchment
- Pollution

Embedded knowledge - Learners should have knowledge and understanding of:

- Ways of preventing the contamination of water and the importance of thereof
- Alternative methods of collecting water
- The importance and role of indicator organisms in water in assessing the safety of water
- The role played by pathogens in the contamination and treatment of water
- The principles of water and wastewater treatment
- Water reticulation
- The sewerage system
- Disposal, recycle and reuse of treated wastewater
- Problems with invader plants in a water catchment area (dams, rivers, lakes)
- Zones of self-purification
- The impact of seasons and different water tables on boreholes
- The importance of knowing relevant water legislation
- The principles on which the National Water Act is based
- The role of safe, clean water in the prevention of disease

APPENDIX G: THE PROPOSED TRAINING MODULE TO MONITOR AND EVALUATE COMMUNITY PROCESSES

The following is the proposed training module to monitor and evaluate community processes as developed by the DWAF/DANCED project in 2003. This module is described as being part of the non-technical training.

PURPOSE

The qualifying learner will be able to monitor and evaluate community interventions in order to develop and implement intervention plans to improve community health.

Specific outcome 1: Identify water and sanitation related practices in the community

Assessment criteria

- Sanitation, water use and hygiene practices are identified.
- Sources of water loss are identified.
- Information is recorded and communicated to relevant people.

Specific outcome 2: Evaluate water and sanitation practices

Assessment criteria

- Information is evaluated.
- A problem analysis is completed.
- Possible solutions are explained.
- Ways to ensure community participation in improved water and sanitation practices are explained.

Specific outcome 3: Develop intervention plan and mobilise community participation

Assessment criteria

- Consensus is reached on problem and solution and roles and responsibilities.
- Intervention plan with success indicators is developed based on agreed solution.

Specific outcome 4: Monitor the implementation and impacts of intervention plan

Assessment criteria

- Intervention is implemented in accordance with plan.
- Identify deviations and develop corrective action.
- Impacts are identified.
- Data is recorded and communicated to relevant persons.

Assessment options

Learners will be assessed through the following methods:

- Oral and written questions
- Observation
- Concepts and terminology
- Sanitation, water and hygiene practices
- Sources of water loss
- Intervention plan and impacts

Embedded knowledge - Learners should have knowledge and understanding of:

- The importance of community participation in problem identification, planning, implementation and monitoring
- Problem solving skills
- Facilitation skills
- Communication and conflict management
- The importance of recording data and using data

APPENDIX H: THE PROPOSED TRAINING MODULE TO MONITOR THE BUDGET RELATED TO COMMUNITY PROJECTS

The following is the proposed training module to monitor and evaluate community processes as developed by the DWAF/DANCED project in 2003. This module is also part of the non-technical training.

PURPOSE

The qualifying learner will be able to manage and control a community budget. This competence will provide accurate information to stakeholders including the community with regard to income and expenditure on projects.

Specific outcome 1: Explain budgets related to community activities

Assessment criteria

- The purpose of a budget is explained.
- A needs assessment for funding is explained.
- Budget control is explained.

Specific outcome 2: Budget preparation and basic accounting

Assessment criteria

- Principles and different methods of accounting.
- Collection and interpretation of data.
- Funding proposal.
- Preparation and approval of budget.
- Record maintenance (reports).

Embedded knowledge - Learners should have knowledge and understanding of:

- Budgets
- Proposals for funding
- Record keeping, evaluation and monitoring

APPENDIX I: GUIDELINES TO GET STARTED AS A VOLUNTEER MONITOR (USEPA, 1998)

1. Determine your personal goals.

Ask yourself why you want to become a volunteer monitor. Do you want to provide high-quality data to be shared with state and local government agencies, or are you more interested in helping local students or community members learn about the environment? Do you want to monitor a specific stream in your neighbourhood or are you willing to be assigned a site by your resource management agency?

Participating in a volunteer programme that provides data to be used by government agencies will usually require that you take part in formal training sessions and commit to a regular schedule of sampling (usually weekly, monthly, or seasonally, depending on the project). If you are more interested in learning about your local waterway and educating others, your time commitment may be less and any training will probably be less formal.

2. Learn about any existing volunteer monitoring programs in your area and around the country.

In the USA, a National Directory of Volunteer Environmental Monitoring Programs, published by the U.S. Environmental Protection Agency (USEPA), helps people locate existing groups nearby and around the country and help them learn about the kinds of monitoring taking place. A central database on who is doing what and where in terms of water quality has not been developed. Volunteers have also not been used on a regular long-term basis. A starting point currently would be to contact your local authority and your Regional Office of DWAF for information on existing water quality monitoring programmes.

Another good place to start is with your local or state environmental protection agency and nature reserves. Even if it does not sponsor a volunteer programme, the agency may be aware of other programmes or groups you can join. Other potential sponsors or sources of information include:

- Local community-based groups such as civic or catchment associations, garden clubs, universities, 'Friends of' groups and activist organisations
- National and regional environmental organisations with offices in your area, such as WESSA

Once you locate volunteer monitoring groups, you will probably find that they offer a variety of opportunities. You might become involved in collecting samples, analysing the results in a laboratory, developing ways to present data, writing reports, speaking to local groups about water resource issues and the volunteer project, producing a newsletter, fundraising, or recruiting and training new volunteers. You might also become involved in organising stream cleanups, planting trees, and other habitat restoration activities. Chances are you will find opportunities that suit your interests and skills.

3. If you can't locate a local group, consider starting one yourself.

If you decide to start your own programme, you'll need to do some basic research to determine how to proceed. To help your research, develop a list of questions that you can discuss with other volunteer programme coordinators. For example:

- What relationships does the programme have with state and local agencies, local businesses, schools and colleges, other groups?
- What kind of monitoring does the programme conduct?
- What are the programme's monitoring costs? How is the programme funded?
- How are volunteers recruited, trained, and retained?
- How is the quality of the data ensured? Does the programme have an approved quality assurance plan?

- What reference materials, training aids, and methods manuals do they recommend?

Starting a volunteer water quality monitoring program is not a simple task. You will need money for equipment and possibly for staff; appropriate meeting, training, and laboratory facilities; a network of knowledgeable people (such as educators, local government representatives, etc.) who are interested in your project and willing to advise and help out; connection to (or sponsorship by) potential data users who can help you plan your project so that it meets *their* needs as well as your own; and organisational skills to manage and maintain the project. Most of all, you will need time to make contacts in the community, design your monitoring plan, develop training sessions, recruit volunteers, revise the programme as it matures, raise funds, analyse the data, and report back to the volunteers and the community.

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Water Research Commission
Private Bag X03, Gezina, 0031, South Africa
Tel: +27 12 330 0340, Fax: +27 12 331 2565
Web: http://www.wrc.org.za