

Chapter 2:

**Functions of Various
Role-players**

CONTENTS

LIST OF FIGURES _____ ii

CHAPTER 2. FUNCTIONS OF VARIOUS ROLE-PLAYERS _____ 2-1

2.1	<i>Various Role-players</i>	2-1
2.1.1	Water Manager/Planner	2-1
2.1.2	Water Boards	2-1
2.1.3	Water Services Authority	2-2
2.1.4	Catchment Committee	2-2
2.1.5	Water User Association	2-2
2.1.6	Hydrogeologist	2-2
2.1.7	Hydrologist	2-3
2.1.8	Drilling/Testing Contractor/Operator	2-3
2.1.9	Other Role-players	2-3
2.2	<i>Public Participation</i>	2-4
2.2.1	Who is “the public”?	2-4
2.2.2	Why do public participation?	2-5
2.2.3	When is public participation required?	2-5
2.2.4	How to design a public participation process	2-8
2.2.5	Risk communication principles	2-17
2.2.6	Monitoring and evaluation of the public participation process	2-19
2.3	<i>Assessment, Planning and Management</i>	2-20
2.3.1	Introduction	2-20
2.3.2	Integration between Assessment, Planning and Management	2-22
2.4	<i>Assessment</i>	2-24
2.4.1	What is meant by assessment?	2-24
2.4.2	Why is Assessment Important?	2-24
2.4.3	Methodology and Details for Assessment	2-24
2.4.4	Other Specialist Studies	2-35
2.5	<i>Planning</i>	2-35
2.5.1	What is meant by planning?	2-35
2.5.2	Why is planning important?	2-35
2.5.3	Framework for water resource planning	2-36
2.5.4	National level planning: Methodology and details	2-36
2.5.5	Catchment Level Planning: Methodology and Details	2-39
2.5.6	Site-specific planning: Methodology and details	2-43
2.6	<i>Management</i>	2-47
2.6.1	What is meant by Management?	2-47
2.6.2	Why is Management Important?	2-47
2.6.3	National Level Management: Methodology and Details	2-48
2.6.4	Catchment level Management: Methodology and Details	2-51
2.6.5	Site-specific Management: Methodology and Details	2-55

LIST OF FIGURES

Figure 2.1: Generic steps in a public participation process _____	2-9
Figure 2.2: Level of public participation _____	2-11
Figure 2.3: Linkages between assessment, planning and management _____	2-22
Figure 2.4: Process for the integration of assessment, planning and management _____	2-23
Figure 2.5: Assessment Process _____	2-26
Figure 2.6: Process for national (reconnaissance) level planning _____	2-37
Figure 2.7: Process for catchment (pre-feasibility) level planning _____	2-40
Figure 2.8: Strategic assessment matrix for water use options _____	2-41
Figure 2.9: Pre-feasibility level screening of options _____	2-42
Figure 2.10: Process for site specific (feasibility) level planning _____	2-44
Figure 2.11: Process for national level management _____	2-49
Figure 2.12: Process for catchment level management _____	2-52
Figure 2.13: Process for site-specific management _____	2-56

CHAPTER 2. FUNCTIONS OF VARIOUS ROLE-PLAYERS

2.1 *Various Role-players*

A structured approach to the effective assessment, planning and management of the groundwater resources is required. Efforts to coordinate the assessment, planning and management of groundwater resources may be led at a local, catchment or national level.

2.1.1 **Water Manager/Planner**

The typical role of a Water Manager/Planner at catchment or local level is to assess the water use requirements and to identify target areas within the aquifer system(s) where these needs can be addressed. This may be based on advice from national level or arise directly from local requirements. The responsibilities of the Water Manager/Planner include the following tasks, among others:

- Reconcile water availability and demand
- Assess water requirements
- Identify target areas within the aquifer system(s) for potential resource development and requirements for the protection of the resource
- Prepare the Scope of Work of the identified task(s)
- Determine what hydrogeological expertise is available and required
- Determine whether a specialised hydrogeological consultant is needed
- Be able to assess proposals and tenders
- Appoint a recognised specialised hydrogeologist, and
- Appoint an experienced contractor on the basis of a tender and technical specification.

2.1.2 **Water Boards**

Water Boards are organs of state that are established to provide water services to other water services institutions. Water Boards may be responsible for implementing and maintaining water use schemes, based on abstraction from aquifers that have been identified through the assessment and planning process. Where this is the case, the responsibilities of the Water Board will be similar to those detailed for the Water Manager.

2.1.3 Water Services Authority

The Water Services Authority is responsible for the provision of water services to the end user. The Water Services Authority is responsible for preparing a Water Services Development Plan (WSDP) within its area of jurisdiction. This plan will include details on the use of water from and the expected development of the aquifer system(s). The Water Services Authority will appoint a Water Manager or Water Board.

2.1.4 Catchment Committee

The Catchment Committee is responsible for day-to-day management of the water resources within a WMA or local catchment. The Committee will be responsible for management functions, such as water use control (including licensing), resource assessment, and management of the available resources.

2.1.5 Water User Association

The Water User Association is responsible for the day-to-day management of the water resources being utilised, including abstraction from aquifer systems. The primary functions of the Water User Association will include monitoring and management of the water resource, enforcement, and groundwater protection.

This will be undertaken in consultation with the Catchment Committee.

2.1.6 Hydrogeologist

The specialist knowledge to undertake groundwater investigations may be available within the institutional framework of the Department's National Office and/or Regional Offices, WSPs, CMAs or WUAs. Such expertise may also be obtained from an external Professional Service Provider.

The Hydrogeologist would typically undertake the following tasks:

- Report to, and liaise with, the Water Manager, Water Planner and Water Users, as applicable
- Draw up a suitable programme of work to fulfil the objectives of the Scope of Work as specified by the Water Manager/Planner
- Ensure the application of correct scientific assessment/development methods
- Prepare technical specifications for borehole drilling, testing and equipping
- Recommend the appointment of contractors, as applicable
- Ensure adherence to the technical specifications by the appointed contractor by being responsible for field supervision

- In the event that the drilling of new boreholes is required, select drilling locations according to the application of sound scientific principles and techniques, as described in Section 2.4.3 of this Guideline, and
- Make recommendations based on the technical specifications.

One of the most critical functions of the Hydrogeologist is to prepare technical reports and to make recommendations on development, target areas, sustainable aquifer resources, sustainable borehole yields, well-field configuration, monitoring protocols and potential environmental and other impacts that could arise as a result of using groundwater resources. The exact nature of any assessment, however, will be based on the original Scope of Work.

2.1.7 Hydrologist

Because of the large surface water – groundwater interaction component associated with certain aquifer systems (e.g. primary aquifers and dolomites) the Hydrologist is described as a specific role player. The Hydrologist is responsible for reviewing and assessing the surface water requirements and potential impacts. The hydrologist will form part of the team assessing the integrated use and protection of the water resources. Interaction between the Water Manager, the Hydrogeologist and the Hydrologist is essential in the assessment, planning and management of the aquifer system(s).

2.1.8 Drilling/Testing Contractor/Operator

The Drilling/Testing Contractor/Operator is responsible for:

- Undertaking the drilling and construction of boreholes according to the applicable technical specification, and
- Test pumping boreholes according to the applicable technical specification.

The technical specifications must detail what is required of the contractor. Model drilling and testing specifications are described in Appendix A.1 and Appendix A.2 respectively.

The contractor will typically report to the Water Manager or the appointed Hydrogeologist.

2.1.9 Other Role-players

The roles and responsibilities of other role-players (District and Local Municipalities, Water Forums, ward councillors and task teams) are summarised in Section 1.7.2 of this Guideline. The task teams in particular will provide technical input for the management of the groundwater resources.

2.2 Public Participation

The Department has developed *Generic Guidelines for Public Participation* (September 2001) which provide a generic approach to understanding the value of public participation in decision-making processes and assisting the Department in implementing public participation in its activities. These Generic Guidelines highlight the objectives and benefits of public participation, the principles, methods and tools for public participation, generic processes and guidelines for implementation, contribution of public participation towards sustainable development, as well as recommendations to the Department on how to improve public participation. The Generic Guidelines therefore serve as the main reference for conducting public participation processes.

An introduction on how to conduct public participation for groundwater development is included in Section 1.8, and provides definitions of public participation and its benefits. This Chapter has been designed to assist the Water Manager, in all aspects of public participation. It describes how to engage the public (i.e. authorities, water users, directly affected parties and other interested and affected parties) to participate in the management of these water resources in order to achieve sustainability.

The following sections provide a brief summary (the details are contained in the Department's *Generic Guidelines for Public Participation*) on aspects such as: when to undertake public participation; at what level to pitch it; how to identify stakeholders; how to analyse the stakeholder profile; what methods to adopt to engage stakeholders; and how to deal with stakeholders' issues of concern. Also described are the principles of risk communication, ongoing awareness creation and building and maintaining good relations with water users and communities depending on groundwater resources.

2.2.1 Who is "the public"?

There is no single "public." The public is made up of many different and diverse groups. Some may participate throughout a process, while some may only participate during part of the process. Some may enter the process late or leave early.

The International Association for Public Participation (IAP2) defines "the public" as: "*Any individual or group of individuals, organisations or entities with an interest in the outcome of a decision. They are often referred to as stakeholders. They may be, or perceive that they may be, affected directly or indirectly by the outcome of a decision. Internal stakeholders (individuals who work for or with the decision-making organisation) are also part of the public.*"

"Stakeholders" are those individuals, groups, communities, organisations, associations or authorities whose interests may be positively or negatively affected by a proposal or activity, and/or who are concerned with a proposal or activity and its consequences. The term therefore includes the proponent or developer, the authorities and all interested and affected parties (I&APs).

“Directly affected parties” are those people who will or may be directly impacted (e.g. farmers using water from aquifer systems for irrigation).

2.2.2 Why do public participation?

Public participation involves stakeholders representing different sectors of society, technical specialists, authorities and project proponents who work together in a joint effort to produce better decisions than if they had acted independently. Public participation is mainly conducted to:

- Satisfy local regulatory requirements (e.g. South African Constitution, National Water Act, Environment Conservation Act, National Environmental Management Act)
- Satisfy Departmental specific guidelines (e.g. the Department of Water Affairs and Forestry’s Generic Guidelines for Public Participation)
- Satisfy international Best Practice principles for public participation
- Enrich decision-making processes, and
- Add value beyond the lifespan of a project, that is, to achieve and/or contribute to sustainable development.

The value of public participation to developers and the authorities is that stakeholders often help them to think through a proposed project, its implementation and management. Stakeholders can often give an up-front indication of environmental or social issues that may cause project difficulties at a later stage. Through the public participation process, stakeholders therefore provide their input and advice “free of charge” and assist developers and authorities to understand the environmental and social consequences of their decisions.

2.2.3 When is public participation required?

As mentioned in the Department’s *Generic Guidelines for Public Participation*, “the Constitution of South Africa sets out the Government’s responsibility to provide the public with the opportunity to be involved in Government decisions that affect their lives.” Thus, the Constitution lays the foundation for the necessity of public participation in any future development project, and this responsibility is reflected in many, if not all, of the South African Government’s regulations. In particular, public participation, or the requirement for public participation, is an integral part of the Department’s acts, policies, strategies and regulations, and other non-regulatory processes (see **Box 1** for examples of legislative, regulatory and non-regulatory processes).

From an international perspective, the training guideline, Southern African Institute for Environmental Assessment (SAIEA) 2005 *Training Course: Public Participation in Environmental Assessment in Southern Africa*, contains an extensive list of Southern African Development Community’s Protocols, Declarations, Charters and Memoranda of Understanding, Agreements, Treaties and International Conventions that underpin the

importance of public participation, particularly in cases where water resources are shared by different countries (see **Box 2**).

Apart from all the above regulatory requirements for public participation, it is always beneficial to adopt it as a Best Practice principle as part of the process to assess, plan and manage groundwater resources. For example, public participation is vital in the following situations:

- When planning the development of a waste site close to a groundwater resource
- When planning to abstract water from a groundwater resource close to a sensitive ecological system
- When planning a housing development close to a potentially vulnerable aquifer system (e.g. primary or dolomitic water resource)
- When communicating potential or actual risks associated with aquifer system(s) such as subsidence due to dewatering aquifers, and
- When there is a need to create awareness and build understanding about groundwater resources in order to plan and manage the resource.

These are just a few examples from an extensive list of when to conduct public participation. If there is uncertainty as to when to conduct public participation, it is best to consult the Department: Water Affairs and Forestry.

The following section provides some references that can be used to design a public participation process.

Box 1: Examples of legislative, regulatory and non-regulatory processes

Regulations:

- *Constitution of the Republic of South Africa (Act 108 of 1996)*
- *National Water Act (Act 36 of 1998) and the White Paper on Water Policy (30 April 1997)*
- *Water Services Act (Act 108 of 1997) and the White Paper on Water Use and Sanitation (November 1994)*
- *National Forests Act (Act 84 of 1998)*
- *National Veld and Forest Fire Act (Act 101 of 1998)*
- *National Environmental Management Act (NEMA) (Act 107 of 1998)*
- *Environment Conservation Act (Act 73 of 1989)*
- *Promotion of Access to Information Act (Act 2 of 2000)*
- *Minerals and Petroleum Resources Development Act (Act 28 of 2002).*

Policies and Strategies:

- *White Paper on Water Policy (30 April 1997)*
- *White Paper on Water Use and Sanitation (November 1994)*
- *Batho Pele – White Paper on Transforming Service Delivery (September 1991)*
- *National Water Resource Strategy (2004)*

- *Draft Position Paper for Water Allocation Reform (2005).*

Non-regulatory requirements:

In addition to the above-mentioned policies, other non-regulatory processes within the Department require public participation, including:

- *Waste Management and the Minimum Requirements (DWAF, First Edition, 1998)*
- *CMA/WUA Guide 4: Public Participation for Catchment Management Agencies/ Water User Associations (DWAF, 2000)*
- *Water Quality Management Series, Volumes 1-3 (Sub-series No MS 8.2, Edition 1, March 2003).*

Box 2: SADC Protocols, Declarations, Charters, Memoranda of Understanding, Agreements and Treaties

The importance of public participation is underpinned by the existing SADC Protocols, Declarations, Charters, Memoranda of Understanding, Agreements and Treaties, as listed below¹. Web addresses are also supplied.

SADC Protocols

- *Protocol on Control of Firearms, Ammunition and other related materials*
- *Protocol Against Corruption*
- *Protocol on Culture, Information and Sport*
- *Protocol on Illicit Drug Trafficking*
- *Protocol on Education and Training*
- *Protocol on Energy*
- *Protocol on Extradition*
- *Protocol on Fisheries*
- *Protocol on Forestry*
- *Protocol on Health*
- *Protocol on Immunities and Privileges*
- *Protocol on Legal Affairs*
- *Protocol on Mining*
- *Protocol on Mutual Legal Assistance in Criminal Matters*
- *Protocol on Politics, Defence and Security Cooperation*
- *Protocol on Shared Watercourse Systems Revised*
- *Protocol on Trade*
- *Protocol on Transport, Communications and Meteorology*
- *Protocol on Tribunal and Rules of Procedure Thereof*

¹ Adapted from Southern African Institute for Environmental Assessment (SAIEA) 2005. Training course - Public Participation in Environmental Assessment in Southern Africa. Developed as part of the SAIEA Calabash Project. First Edition, 2005.

- *Protocol on Tourism*
- *Protocol on Wildlife Conservation and Law Enforcement*

<http://www.sadc.int/index.php?lang=english&path=legal/protocols&page=index>

SADC Declarations

- *Declaration and Treaty of SADC*
- *Declaration on Gender and Development*
- *Declaration on Information and Communications*
- *Declaration on Productivity*
- *Declaration on HIV/AIDs*

<http://www.sadc.int/index.php?lang=english&path=legal/declarations&page=index>

SADC Charters

- *Charter of the Regional Tourism Organisation of Southern Africa (RETOSA)*
- *Charter of Fundamental Social Rights in SADC*

<http://www.sadc.int/index.php?lang=english&path=legal/charters&page=index>

SADC Agreements

- *Agreement Amending the Treaty of SADC*

<http://www.sadc.int/index.php?lang=english&path=legal/agreements&page=index>

SADC Memoranda of Understanding

- *Memorandum of Understanding on Macroeconomic Convergence*
- *Memorandum of Understanding on Cooperation in Taxation and Related Matters*
- *Memorandum of Understanding on SQAM*

<http://www.sadc.int/index.php?lang=english&path=legal/moa&page=index>

SADC Treaties

- *Declaration and Treaty of SADC*
- *Amended Declaration and Treaty of SADC*

<http://www.sadc.int/index.php?lang=english&path=legal/treaties&page=index>

2.2.4 How to design a public participation process

Public participation processes are not carved in stone, nor is there a blue-print for such processes. A public participation process must be designed to satisfy local regulatory requirements, and international requirements if conducted across the borders of different countries. These may include one or more of the National Water Act, the EIA Regulations, the National Environmental Management Act, the Environment Conservation Act and international best practice principles as proclaimed by the International Association for Public Participation (IAP2) and other applicable legislation and/or protocols (see **Box 2**).

Very few of these regulations and best practice principles provide guidelines on how to conduct public participation. The Department's *Generic Guidelines for Public*

Participation (September 2001), specifically Section 4, describe the sixteen principles of public participation that must be considered when designing a process to engage stakeholders. Another valuable resource on how to conduct public participation, albeit in Environmental Assessment, is the training guideline by the Southern African Institute for Environmental Assessment (SAIEA) 2005, *Training course - Public Participation in Environmental Assessment in Southern Africa*.

It is important to note that the context to public participation at national level is different to that at catchment and site-specific levels. Each has different requirements and these must be borne in mind when designing a public participation process and when implementing methods to achieve desired outcomes. However, certain of the guidelines must be considered and certain generic steps must be followed when conducting an effective public participation process, whether undertaken on a national, catchment or site-specific level. These generic steps are outlined in Figure 2.1 and are briefly discussed in the following sections. More details are contained in Section 5 of the Department's *Generic Guidelines for Public Participation*.

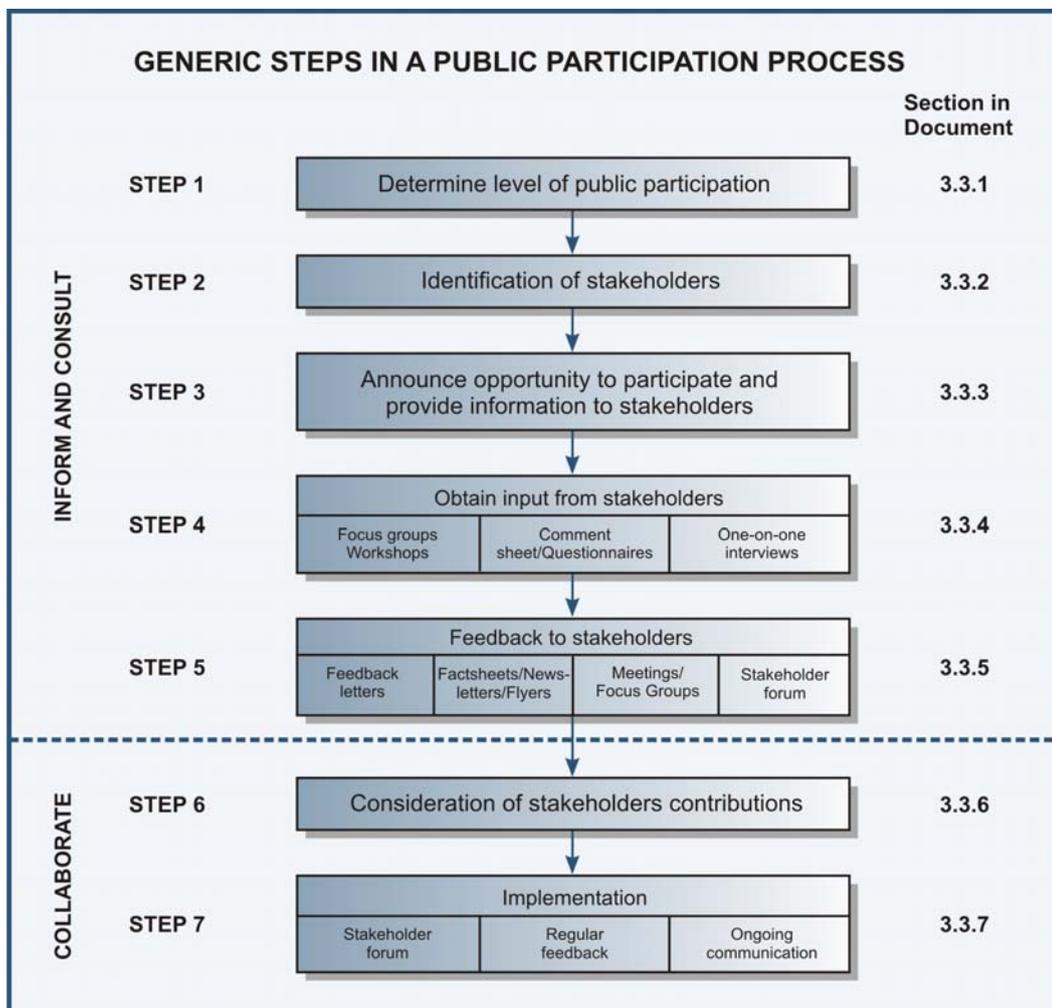


Figure 2.1: Generic steps in a public participation process

Step 1: Determine the level of public participation

A confusing aspect about public participation is that different parties have different definitions and use different terminology. What is important is that most organisations recognise public participation as a spectrum or a continuum rather than an absolute (Southern African Institute for Environmental Assessment (SAIEA) 2005, *Training course - Public Participation in Environmental Assessment in Southern Africa*).

The International Association of Public Participation (2005) differentiates between five levels of public participation in its Spectrum of Public Participation, each with different objectives and each with increasing public impact on decision-making:

- **Inform:** The objective is to provide the public with balanced and objective information to enable people to understand the problem, alternatives and/or solutions
- **Consult:** The objective is to obtain public feedback on analysis, alternatives and/or decisions, in particular those points that are relevant to the subject at hand. It involves acknowledging concerns and providing feedback on how public input has influenced the decision
- **Involve:** The objective is to work directly with the public throughout the process to ensure that public issues and concerns are understood and considered at every stage and are directly reflected in a particular proposal or activity
- **Collaborate:** The objective is to work with the public as a partner on each aspect of the decision, including the development of alternatives and the identification of the preferred solution; and
- **Empower:** The objective is to place final decision-making in the hands of the public.

In the development of policies, strategies and guidelines, public participation mainly takes place at the “Inform” and “Consult” levels of the continuum, and sometimes at the “Collaborate” level. As an example, the national policy consultation process for the National Water Resource Strategy (NWRS) evolved from the consult level to a collaborative level due to the nature of the project. A project does not necessarily need to remain at a specific level but can grow from one level into another depending on the type of the project, its sensitivity and the interest generated by the project.

With regard to the assessment, planning and management of groundwater resources in highly impacted and sensitive areas (e.g. where water has been over-abstracted by farmers, or slimes dams built), public participation should be pitched at the “Inform”, “Consult” and “Collaborate” levels. This will ensure the involvement of stakeholders in the management and protection of the resource. However, in areas where impacts to water resources are low, public participation needs to take place only at the “Inform” level. This approach applies equally to the national, catchment and site-specific levels.

The level of public participation is dependent on the anticipated scale of impacts and sensitivity of public perceptions, as illustrated in Figure 2.2.

NOTE:

For more information or a guideline to implementation, refer to section 6.2.2 of the Department's Generic Guidelines for Public Participation (September 2001). Section 7 of this volume also provides information on the methods of public participation.

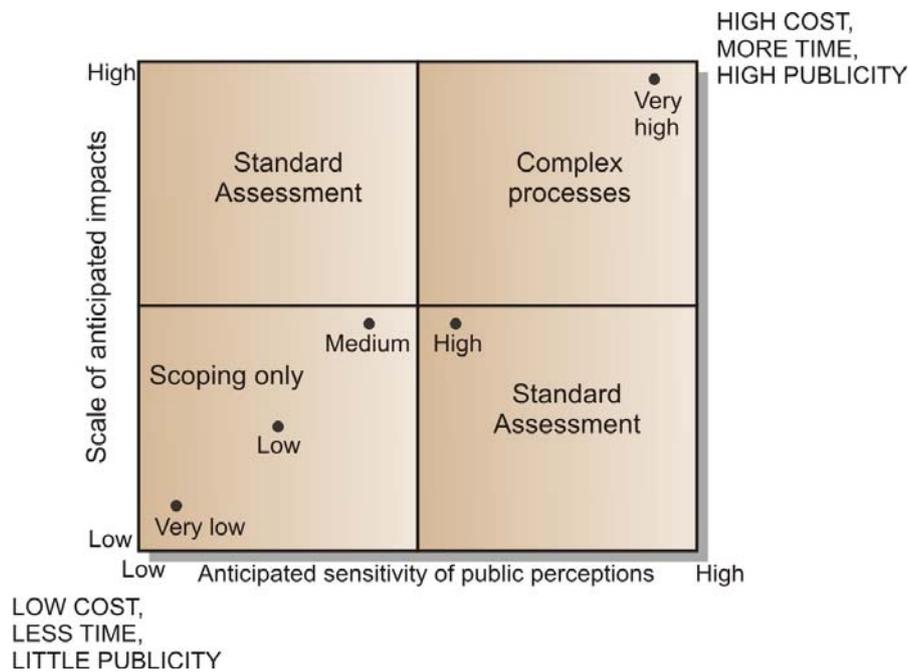


Figure 2.2: Level of public participation

Step 2: Identification of stakeholders

When identifying stakeholders with whom to consult, it is important to bear in mind the scale of the process (i.e. national, catchment and/or site-specific) and to be sensitive to the power relationships within the stakeholder groups (SAIEA 2005, *Training course - Public Participation in Environmental Assessment in Southern Africa*). This can play a vital role in the degree to which stakeholders will actively participate in the project. Up-front knowledge about the dynamics in stakeholder groups can also determine the success of the process. Before identifying stakeholders in the project area, it is important to consider the following questions (SAIEA 2005, *Training course - Public Participation in Environmental Assessment in Southern Africa*):

- Is there an existing stakeholder profile in the project area?
- Who needs to be informed of the process and brought on board?
- What are the traditional systems of power, government and authority?
- What languages are spoken?
- What specific cultures, traditions or rituals are important?
- What are the mechanisms of communication in the community?
- Who are the dominant individuals and groups among the stakeholders or community?
- What are the correct channels to use when engaging with stakeholders?
- Are there any special interest groups that need to be involved in the project and how can women, the youth, the disabled and people with HIV/AIDS be incorporated into the public participation process?
- Are there any specific marginalised people in the project area who may need special assistance to attend meetings (e.g. transport)?
- What capacity to participate does community and civil society groups have? For example, do they have access to time, finances, knowledge and skills to enable them to get involved? Do they lack access to these resources and/or have limited resources to get involved? What can be done to overcome this problem?
- What lessons can be learned from previous experience?
- Who will benefit from the planning, assessment and management of groundwater resources?
- Who might be negatively affected by the regulation of use of groundwater resources?
- Who might stand in the way or obstruct the process of licensing water use from groundwater resources?
- Who may have resources, such as skills and finances, to contribute to the planning, assessment and management of groundwater resources?
- Who are the relevant decision-makers in the process?

To ensure that no group of stakeholders has been left out, categorise the list of stakeholders into different sectors of society. These sectors are listed in **Box 3**. They may not all be relevant but the list can be used for cross-checking purposes. Every area has a unique group of stakeholders (e.g. some areas may have more rural communities than others) and it is important to identify the right people to participate in the project. Take care not to exclude marginalised people merely because they may need extra care and attention.

Box 3: List of sectors of society

- National government
- Provincial government
- Local government
- Tribal authorities
- Mining
- Industry
- Financial institutions
- Business and commerce (e.g. farmers' cooperatives involved in the sale of centre pivot irrigation systems to farmers)
- Transport
- Agriculture (e.g. farmers associations)
- Environmental bodies, incl. NGOs and conservation groups
- Water users (e.g. individual farmers and landowners) and user associations
- Community-Based Organisations, residents' associations, women's groups, the youth, disabled, people with HIV/AIDS
- Labour unions
- Power
- Health
- Education
- Religious groups, churches
- Other, as applicable.

NOTE:

For more information on how a final stakeholder list might look, see Section 6.2.3 (Boxes 9 and 10) of the Department's Generic Guidelines for Public Participation (September 2001).

The stakeholder list should include marginalised groups such as women, the youth, the poor, disabled people, rural people, emerging farmers/ etc.

When developing the stakeholder database, and to ensure that all relevant stakeholders are included, it is important to network with the Department's Regional Offices. Comprehensive existing stakeholder databases developed for other processes are held by the Department and these can be used for public participation. These processes included developing the following Public Participation databases which are available:

- The National Water Resource Strategy
- Water allocation
- NORAD
- KOSH study, and

- DANIDA-funded Integrated Water Resource Management process
- Conference databases e.g. Water Summit, Groundwater conferences.

Step 3: Announcing the opportunity to participate and providing information to stakeholders

Several techniques are available to announce the opportunity for stakeholders to participate in the assessment, planning and management process of groundwater resources. These include:

- Announcement letters
- Paid advertisements in national, regional or local newspapers (preferably placed in the main body of the newspaper and not in the classifieds or legal sections)
- Mail-drops
- Newspaper inserts, and
- Press releases.

Techniques to share information include:

- Printed material (e.g. fact sheets, newsletters, brochures, posters, flyers)
- Information repositories at public places (e.g. libraries, distribution centres, community centres, schools)
- Technical reports (e.g. proposed Management Plan for specific aquifer systems)
- Electronic information
- Poster displays
- Briefing meetings/workshops (this technique worked well in developing this guideline document and works well when one needs to obtain stakeholder input), and
- Industrial theatre (this technique works especially well in rural areas where literacy levels are low and in dealing with young stakeholder groups).

As previously mentioned, there is no “blueprint public participation process” as each geographical area has its own unique group of stakeholders. The social profile of these stakeholders should be well-known to the public participation practitioner or the Water Manager. For example, when convening meetings with people living in remote rural areas, it would be considered impractical to invite them by letter to a meeting 100 kilometres from where they live. One should be aware that such cases may involve considerable additional effort. There may often be a need to first create awareness about the groundwater resource(s), and to provide people with sufficient information in a way that is applicable to their level of comprehension (e.g. visual posters with photographs,

community theatre) in order to build trust and to capacitate them to contribute meaningfully.

The Water Manager, who has on-going contact with stakeholders in his area, generally tends to know stakeholders' preferences in how they like to be consulted. Thus, certain groups may prefer informal discussions around a table with key representatives, while other groups may prefer formal workshops. It may sometimes be necessary to combine techniques to share information.

Step 4: Obtaining input from stakeholders

Obtaining input from stakeholders will not only enrich the public participation process but will build understanding, trust, ownership and a willingness to work together. However, one will need to be sensitive to the methods adopted when communicating with different stakeholder groups. For some groups, a document describing the project may be sufficient, while others may require small meetings with visual presentations and illustrations.

Many techniques are available to obtain input from stakeholders, including one or a combination of the following techniques:

- Information hotline
- Electronic media
- Comment sheets and questionnaires
- Community facilitators visiting communities
- Site visits
- Focus group meetings
- Open houses
- Public meetings and workshops, and
- One-on-one interviews.

NOTE:

Section 6.2.3.2 and Boxes 13, 14, 15 and 16 of the Department's Generic Guidelines for Public Participation (September 2001) provide more information about how to convene meetings with stakeholders.

Note that the advantage of bringing people together in a meeting, workshop or open house exposes the different viewpoints of different groups to each other. This has the benefit of creating better understanding and appreciation of each other's situations and challenges, and developing new ideas and solutions.

Step 5: Feedback to stakeholders

Regular feedback (every three months) to stakeholders is an essential part of the public participation process. It ensures that stakeholders are constantly aware of new information, decisions and the consequences of the decisions and/or activities. It also encourages their continued involvement in the process. Feedback to stakeholders can be by means of:

- Feedback letters
- Issues and Response Reports
- Media releases
- Fact sheets, newsletters, brochures, flyers
- Meetings, workshops, open houses, focus groups, and
- Stakeholder forums.

NOTE:

See Section 6.2.3.3 and Box 17 of the Department's Generic Public Participation Guidelines (September 2001) for information on how to solicit feedback from stakeholders.

Step 6: Consideration of stakeholders' contributions

The international Best Practice guidelines for public consultation specifically note that stakeholders should have the opportunity to verify that all comments they have raised have indeed been considered. Stakeholders' contributions should be reflected back to them after each milestone in the process. They need to feel heard, otherwise they either lose interest or mistrust the process. In particular, they must be able to see *where* their issues have been taken up in the process, and if not, must receive an explanation as to why not. Experience also shows that, once stakeholders have the opportunity to consider the diversity of views raised by the various sectors of society, it is easier to accept trade-offs as a result of conflicting views.

An Issues and Response Report is useful in this regard. This report should be expanded as the process progresses, and serves to provide feedback to stakeholders as well as acting as a useful record of all contributions.

Acknowledgement of stakeholders' contributions is important. Written contributions can be acknowledged in writing (letter) and contributions at meetings by distributing the proceedings within one month of the meeting, formally asking those who attended to

ensure, within five working days of receiving the proceedings, that their contributions have been captured accurately.

Step 7: Implementation

To ensure sustainability of the process, stakeholder involvement should continue into the implementation phase, in this case the implementation of a management plan for groundwater resources. This can be achieved through:

- Ongoing regular feedback
- Ongoing communication and awareness creation, and
- Formation of a Stakeholder Forum or a Stakeholder Monitoring Committee.

2.2.5 Risk communication principles

Conducting public participation in sensitive areas with sensitive stakeholders can pose a challenge to those involved in the process and may require conflict resolution skills or knowledge of the main principles of risk communication. For example, dolomites occurring in urban areas are considered to be a sensitive matter, therefore the application of risk communication principles may be valuable to Water Resource Managers.

More than three decades of research and hundreds of articles published in scientific journals underpin the science of risk communication. Sandman (1986) says that *“the most common sources of risk information are people who are professionally inclined to ignore feelings (technical specialists, engineers, scientists). And how do people respond when their feelings are ignored? They escalate — yell louder, cry harder, listen less — which in turn stiffens the experts, which further provokes the audience. The inevitable result is the classic drama of stereotypes in conflict: the cold scientist or bureaucrat versus the hysterical citizen.”*

Water Managers who have contact with stakeholders can reduce the Department’s social risk by becoming familiar with and applying the basic principles of risk communication. Trust, credibility, personal contact and control form the basic foundation for risk communication. Some pointers are listed:

- Meaningfully interfacing with third parties requires experts and technical specialists to switch from right brain (content, data, statistics, science, facts) to left brain (feelings, empathy, respect; collaborative problem-solving)
- Accept and involve the public as a legitimate partner; listen to their specific concerns
- Understand that the risks that kill people and the risks that upset people are often completely different

- Do not use the DAD model: Decide, Announce, Defend. Leave room for dialogue and resolving disputes before decisions are implemented, otherwise costly delays may result later on
- Express caring, empathy and commitment, and respond humanely. Do not trivialise people's feelings. These attributes account for more than 50 percent of trust in high-concern situations. When people are worried and upset, they don't care what you know until they know that you care. People often decide if a person is caring within as little as nine seconds
- Show respect. Do not negate people's concerns just because you are not of the same political orientation as they are. Their concerns may be real and sufficiently substantial to support legal action; listen first, then formulate your response
- Adapt to the fact that many people use health, safety and environmental risks as a proxy or surrogate for other social, political or economic concerns. Sometimes it is the only way they know how. Assist them to express their unspoken but real concerns
- Do not use complex and difficult probabilistic or technical language to communicate information about risks. Keep it simple. Avoid technical jargon and any words that teenagers won't understand
- When people speak emotionally, do not immediately respond with data, but with sympathy and caring; breaking a conflict is often "a matter of explicitly acknowledging the feeling (and the legitimacy of the feeling) before trying to explain anything substantive — because any effort to explain substance first will be experienced by people as just another way of not noticing how they feel"
- Be honest, frank and open. Openly acknowledge past misbehaviour and current problems. Explain plans and financial commitment in place to rectify current problems and ask for suggestions
- Coordinate and collaborate with other credible sources. If air quality is the problem, compare emissions to international standards and guidelines. Indicate that the company will be guided by the country's Air Quality Authority. If environmental management is the problem, make it known that the plant environmental management certification/ accreditation is being obtained, and explain what it means (continuous environmental improvement)
- Do not use the "wrong" public relations techniques. While public relations textbooks may highlight the need for quality information and mutually beneficial relationships, public relations often employ techniques such as stonewalling, smoke-screening, whitewashing and blaming someone else (Susskind and Field, 1996)
- Let go of some control. Allow stakeholders to select the dates and times of meetings, to indicate the language of their choice, to indicate by what methods they would like to receive their information, to assist in listing criteria for making choices, and to assist in exploring alternatives. Lay people, "undeterred by conventional expert wisdom, often have good ideas that experts can adapt to the situation at hand; as a minimum, lay people are the experts on what frightens them and what would reassure them"
- Discuss achievements with humility, and

- Honour commitments, and if not possible, be open and transparent about the problems.

2.2.6 Monitoring and evaluation of the public participation process

The monitoring and evaluation of a public participation process is an important component of the process, as it not only determines the way forward but also allows valuable lessons to be learned for future reference. Moreover, it can indicate the value that it has added to the assessment, planning and management of the water resource, and can provide water managers with an idea of the main challenges and how to manage these proactively.

A Public Participation Evaluation Report should be compiled, and should include important considerations in the evaluation process, for example:

- Did the public participation process meet the statutory and other requirements?
- Was the public participation process regarded as sufficient, that is, was it conducted with fairness, in an efficient manner, and with wisdom and stability? Did the outcomes lead to better decisions or management than the stakeholder groups would have been able to achieve individually?
- Did everyone gain something from the process (e.g. increased understanding, access to information, increased capacity to contribute/participate, enhanced partnerships)?
- Was the public participation process conducted well, adequately or incompletely?
- Were there any significant omissions from the process? What were the reasons for these omissions? And
- What are the pointers for improving the public participation process?

Relevant references to existing reading material on monitoring and evaluation of the public participation process are:

- Southern African Institute for Environmental Assessment (SAIEA) 2005. Training course - Public Participation in Environmental Assessment in Southern Africa. Developed as part of the SAIEA Calabash Project. First Edition, 2005.
- Southern African Institute for Environmental Assessment (SAIEA) 2004. A One-Stop Participation Guide. A Handbook for Public Participation in Environmental Assessment in Southern Africa.
- Greyling T and Pietersen T 2006. Guide to Public Participation in Environmental Authorisation: Theory and Practice. Golder Associates Africa, Midrand, South Africa.
- Web sites: International Association for Public Participation – <http://www.iap2.org>.

2.3 *Assessment, Planning and Management*

2.3.1 Introduction

Section 1.1.3 summarises the importance of integrating the assessment, planning and management functions as follows:

- Assessment that is undertaken poorly can lead to poor planning. In turn, poor planning can lead to the adoption of unsuitable options and hence the unsustainable use of the groundwater resource, and
- Poor management is an inefficient use of the time and budget of the Department's operational personnel. However, given the linked nature of the functions, poor assessment, leading to poor planning, can result in the inefficient use of the assessment, planning and management budgets. This should clearly be avoided.

It is thus important that the assessment, planning and management functions are integrated, both vertically (between functions) and horizontally (between national, catchment and site-specific levels).

Figure 2.3 illustrates this integration, with the national, catchment and site-specific levels defined as follows:

- **National level** is not necessarily a geographic descriptor, but rather indicates the level and type of issues that need to be addressed. For groundwater resources in numerous areas, these are typically cross-boundary issues, reconciliation of demand and availability or the interests of different stakeholder groups. These functions and responsibilities may be addressed by Departmental personnel in the National Office or by delegated groups.
- **Catchment level** includes functions and responsibilities that are focussed on aquifer potential and those measures that are required to ensure sustainable development and use. These will include such aspects as defining the water balance, rate of recharge to the aquifer, storage and exploitation potential, Resource Quality Objectives, accessibility of the resource to various users or stakeholder groups, and monitoring procedures. Catchment level functions will also include such issues as defining possible target areas that are suitable for the identified water use needs, and taking into consideration the impacts/unacceptable risks to the environment. These functions will generally be assigned to Departmental personnel in the Regional Offices, or to the CMAs when established and operational. In certain instances, these functions may be delegated to, and undertaken by, the AMC or Catchment Committees.

- **Site-specific level** includes site-specific functions for a particular target area. These will be the responsibility of the Water Service Provider, User Group, private organisation or individual. The users will be responsible for determining the site-specific aquifer potential, water balance, potential impacts, etc. Various well-fields could thus exist and be developed for use in one target area of the aquifer.

Figure 2.3 indicates the linkages between the various functions. The functions are summarised as follows:

- Assessment to a reconnaissance level (desk-top) of detail is undertaken at the national level, where the focus is on water availability (both quantity and quality) and water requirements in an area that typically spans more than one WMA. This assessment is refined to a pre-feasibility level at the catchment level, where the focus will be on defining the resource capability of the target aquifers in the geographical area of interest. A feasibility level assessment of the target area for development (and the ability to use the resource) is the focus at the site-specific level,
- Planning is undertaken at a reconnaissance level of detail at the national level where various options are weighed for further detailed study. The level of detail and accuracy is improved during a pre-feasibility study at the catchment level, where specific options are assessed. A full feasibility study and optimisation of designs is undertaken at the site-specific level, and
- Management of water resources is enabled through water allocation and water use authorisation. Management at site-specific level entails, among others, maintenance and control, monitoring and measurement, data management and reporting, auditing and management of impacts. Review of compliance with water use authorisation conditions is undertaken at the catchment level, as well as managing the cumulative impacts of the various water user groups on the system. The auditing of compliance with strategic goals and strategic reviews is undertaken at the national level.

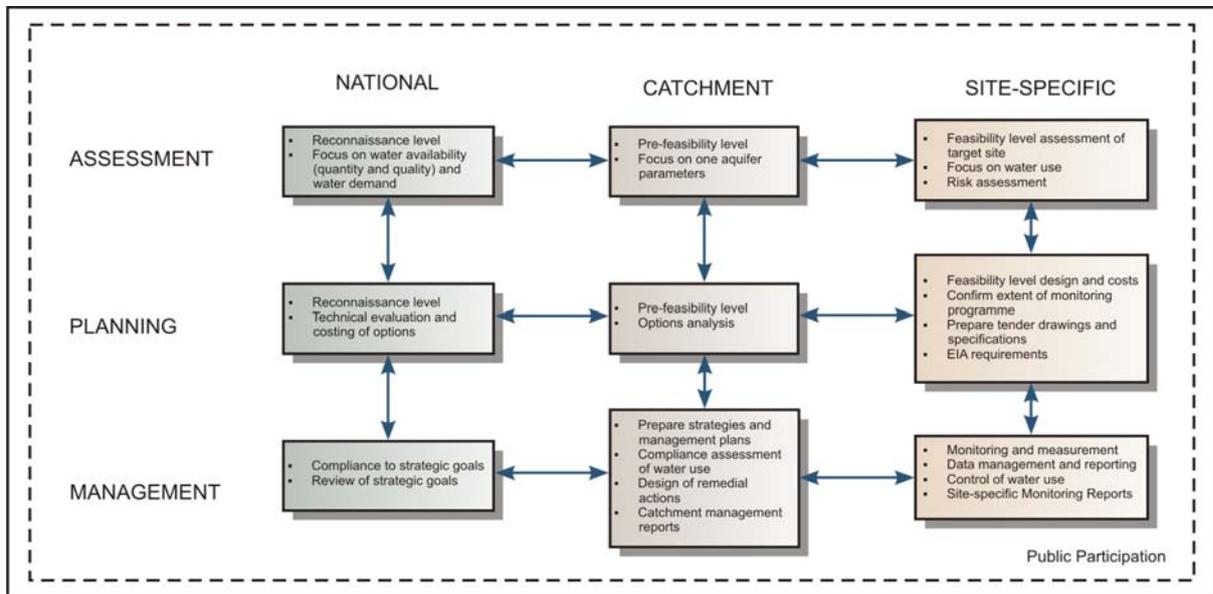


Figure 2.3: Linkages between assessment, planning and management

2.3.2 Integration between Assessment, Planning and Management

Figure 2.4 illustrates the overall recommended process in the integration of the assessment, planning and management functions at the various levels. The diagram illustrates the inputs (from the various catchment level ISPs), the process for assessment, planning and management, and the outputs. In reality, not all steps may need to be followed. For example, the reconnaissance level national assessment may provide sufficient catchment information for the site-specific planning functions. However, if more data is needed for site-specific planning, then it will be gathered at the site-specific level, due to the scale of the area and the level of detail that is required.

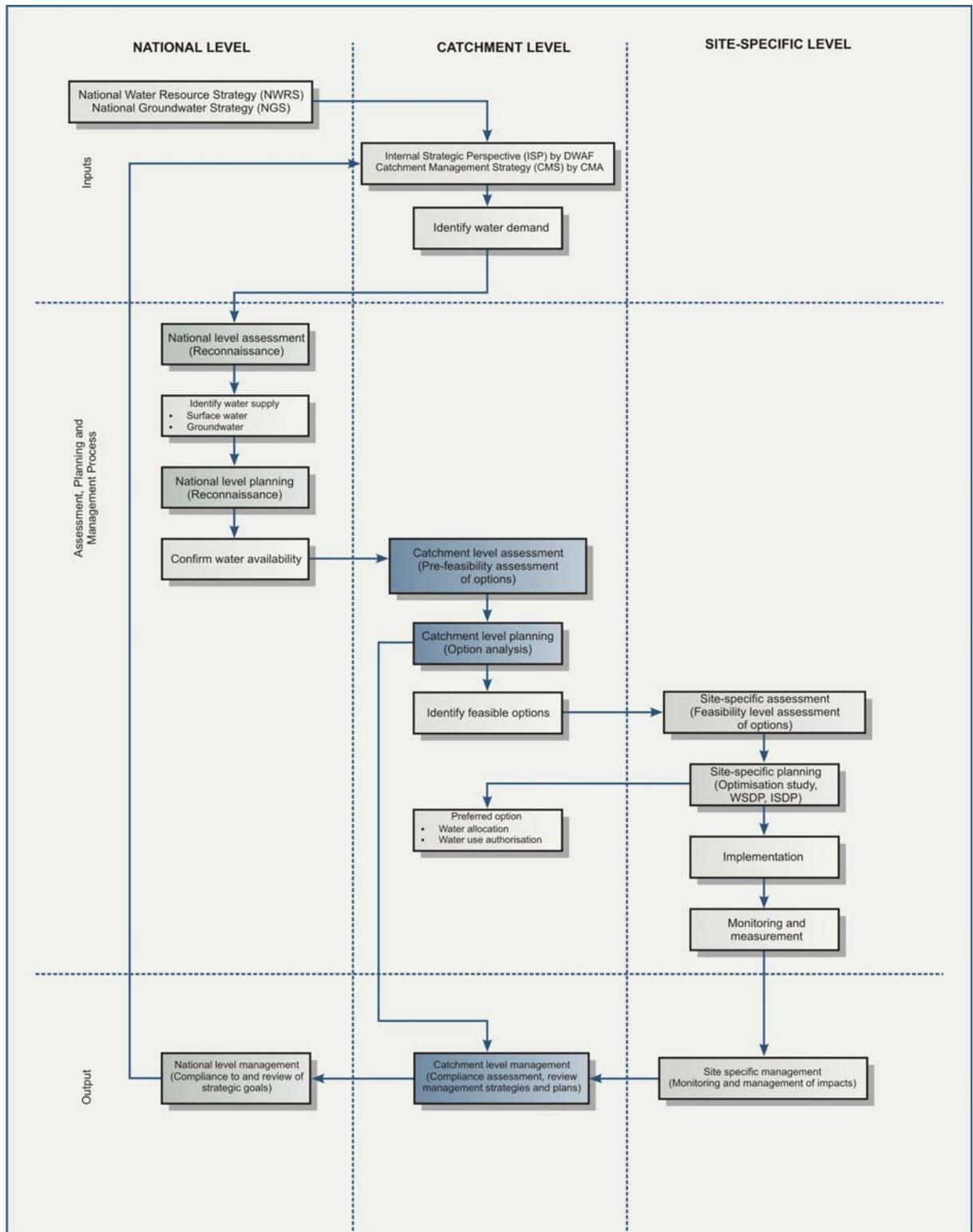


Figure 2.4: Process for the integration of assessment, planning and management

2.4 Assessment

2.4.1 What is meant by assessment?

Assessment is the first step in the IWRM process. It determines the status quo (in terms of both water quantity and quality) of the groundwater resources in a particular WMA or catchment, and defines the geographic extent of the aquifer system(s). Assessment includes the determination of the aquifer resource capability with respect not only to sustainable, economic and technically feasible abstraction but also to the impact of such abstraction on spring and river flow (i.e. ecological requirements). Assessment also summarises existing water requirements for all sector users, taking into account demographic and socio-economic changes.

2.4.2 Why is Assessment Important?

The assessment function is important because:

- The groundwater resource has a high potential availability with good water quality
- Information is not currently, or readily, available in the correct detail and format to answer questions on groundwater availability and quality
- It enables the planning and management functions
- It helps to understand local dependence on the groundwater resource
- It confirms the current impact on, and use or abuse of, the groundwater resource
- It helps to determine what questions are to be addressed at the various levels, and
- It enables risk management (e.g. the use of groundwater during severe drought).

2.4.3 Methodology and Details for Assessment

The steps required to assess the groundwater resources and to prepare inputs for the subsequent planning phases are similar irrespective of the scale (i.e. national level, catchment level or site-specific/local level). The process includes such aspects as existing use, development potential as a bulk or local water supply, importance of springs and baseflow, dependence of ecology and identifying potential impacts. This common methodology and the steps involved are described below. It should be noted that the application of this methodology will vary at the national, catchment or site-specific level due to the scale and/or spatial intensity of the investigations.

National level assessment is likely to be undertaken by personnel of the Department's National Office, with assistance from the Water Manager/Planner. The assessment includes a desk study to obtain information on water availability and requirements over various catchments/ compartments. Depending on the amount and nature of the data

available it might be necessary to undertake the collation of information from boreholes and springs. From this study, the Water Manager will be able to identify issues, areas of water shortage and areas where additional information is required.

Catchment level assessment has its focus on one or more aquifers in a catchment. The aim is to determine the parameters of the target aquifer(s) in sufficient detail to enable catchment level planning (pre-feasibility) studies of these aquifers. Catchment level assessment will therefore require the collection of information from existing boreholes and the siting, drilling and testing of exploratory/monitoring boreholes in key localities to provide the necessary data.

Site-specific assessment includes a detailed assessment of the target area to determine the ability of the aquifer in that area to support the requirements on a sustainable basis. Site-specific assessment thus involves substantial on-site drilling and testing, and may include detailed numerical groundwater modelling.

Figure 2.5 provides details on the assessment process. The various steps in the process are described in the following sections.

Step 1: Undertake desk study and remote sensing

The objective of a desk study is the collation, scrutiny and evaluation of available and relevant meteorological, geographical, geological, hydrogeological and groundwater quality data. The tasks involved in gathering available data/information will typically include:

- Obtaining information related to groundwater, including:
 - Geological and hydrogeological maps
 - Hydrogeological reports
 - Borehole logs
 - Geophysical profiles of exploration and/or monitoring boreholes previously drilled in the area
 - Test pumping results
 - Groundwater quality data, and
 - Monitoring data, studied to gather direct hydrogeological information across the area of investigation

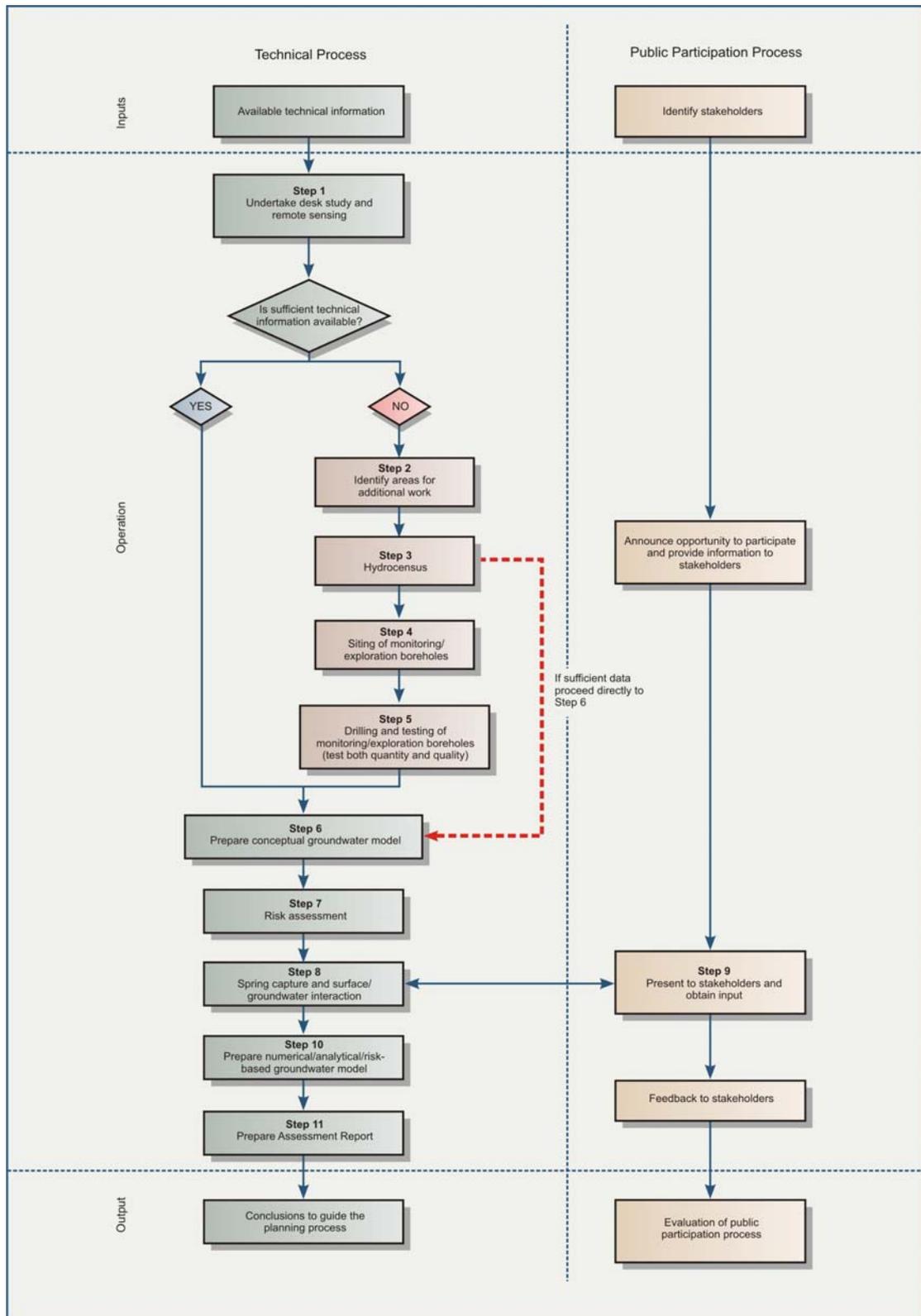


Figure 2.5: Assessment Process

- Collating all relevant information into a desk study report based on the Model Table of Contents (Appendix D2)
- Summarising all available information into a water balance, indicating water availability (quantity and quality) and water requirements, and
- Other aspects, including land use planning and use and potential water requirements.

Aerial photography, satellite imagery, geological and hydrogeological maps form the basis of remote sensing. These may be supplemented with airborne digital terrain mapping and aeromagnetic surveys. Airborne radiometrics may also be of value in areas where the potential of contamination by radionuclides is known or suspected.

This information is used to establish a background or baseline geological and hydrogeological reference for the identified study area. Once the desk study has been undertaken, the level of input required and the necessary programme(s) are identified for further assessment and / or the planning phases.

NOTE:

Further details concerning data requirements are available in the Standard Descriptors for Geosites, DWAF/NORAD, 2004.

NOTE:

The WRC report No. 1090-2/2/03 contains details on assessing terrestrial groundwater dependent ecosystems in South Africa.

Step 2: Identify areas for additional work

Using the results from the desk study, undertake a gap analysis to identify:

- The catchment(s) where there is sufficient information with which to reconcile water availability and requirements (quantity and quality); in these instances, the personnel will proceed to Step 5; or
- The catchment(s) where there is insufficient information for the assessment of water availability and requirements; in these instances, the personnel will list the required information and the methods recommended to obtain the information.

Step 3: Hydrocensus

A hydrocensus is essentially site familiarisation and the collection of data from the study area and surrounding environs. It comprises a census of key boreholes, wells, springs and any other groundwater related information. The extent (intensity and area covered)

of the hydrocensus will depend upon the level of the study (national, local or site-specific) and the particular requirements of the study, but must provide wide coverage of the catchment(s) to allow an overview of the aquifer system(s) to be captured at the necessary level of detail. The Department's National Office, CMA or Water Manager will be responsible for the hydrocensus.

The hydrocensus involves the collection of data from each facility, including:

- GPS co-ordinates
- Owner
- Current use
- Reported yield
- Reported or measured borehole or well depth
- Static water level
- Field measurements of pH and conductivity
- Collection of water samples from key selected boreholes, wells or springs for quality analysis
- Existing equipment
- Possible information that can influence measurement data, and
- Surface water quality should also be considered as part of the hydrocensus for use in surface water - groundwater interactions.

All field data must be recorded on standard hydrocensus sheets (refer to the example in Appendix B) and captured in the relevant electronic database.

The Water Manager will use the hydrocensus data to determine the prevailing hydrogeological conditions, order of magnitude of existing groundwater use and dependence, areas of intensive irrigation, etc.

The success of any hydrocensus is almost entirely dependant on the cooperation of the local communities and private landowners. The Water Manager should thus ensure that prior and considered communication is undertaken by means of public participation channels to inform landowners of the proposed hydrocensus.

If sufficient information is collected during the hydrocensus then proceed to Step 6.

NOTE:

Further details are available in the DWAF/NORAD, 2004 document, Section 3.1: Involving community members in a hydrocensus.

Step 4: Siting of monitoring/exploration boreholes

Monitoring and exploration boreholes may be required in order to provide sufficient information on the target aquifer(s). The number and location of these boreholes will be determined by the level of the study, the nature of the aquifer(s), the results of the desk study and the hydrocensus data.

The Water Manager will ensure that the siting of groundwater exploration and monitoring boreholes is undertaken by a qualified and experienced Hydrogeophysicist / Hydrogeologist. Siting of boreholes for any use by a diviner is **not** permitted.

The Hydrogeologist will undertake the following tasks in siting boreholes:

- Understand the scope and objectives of the assessment and the purpose of the borehole(s),
- Identify or select the general area within the aquifer where boreholes are required,
- Interpret the black and white stereo pair air photography and satellite imagery in and surrounding the area of interest to identify structural features (e.g. dykes, faults, fracture zones), weathering and other features (e.g. karst) of importance to groundwater occurrence,
- Undertake a geological appraisal and select sites for the geophysical survey, and
- Undertake a geophysical survey involving the application of proven and appropriate techniques. Such techniques will involve one or more of the following:
 - Electrical resistivity
 - Electromagnetics
 - Magnetism
 - Gravity, and
 - Seismics.

The application of seismic techniques is not recommended for groundwater exploration due to its high cost and the availability of alternative techniques (mentioned above).

NOTE:

Further information concerning geophysical techniques can be found in numerous references. The recommended references are: A Practical Manual on the Resistivity Method, prepared by J S V Van Zijl, 1985, published by the CSIR.

The Magnetic Method, a Geophysical Field Manual for Technicians, No. 1, published by the South African Geophysical Union, and The Electromagnetic Method, a Geophysical Field Manual for Technicians, No. 3, published by the South African Geophysical Union. Applied Geophysics by W. M. Telford, L. P. Geldart, R. E. Sheriff, ISBN 0521339383.

Step 5: Drilling and testing of exploratory/monitoring boreholes

Exploratory/monitoring boreholes must be drilled to the required technical specifications by an experienced contractor. The Water Manager/Hydrogeologist will ensure that the appointed contractor understands and signs the relevant technical specifications.

Field operations should be undertaken under the supervision of the Hydrogeologist appointed by the Water Manager to ensure that the boreholes are drilled:

- In the correct location
- To the required depth, and
- According to the applicable specifications (Appendix A1 and Appendix A2).

*NOTE:
Additional information on groundwater protection is available in the DWAF/NORAD, 2004 document: Guidelines for protecting boreholes and wells.*

The supervisor will prepare:

- A geological log of the lithology
- A construction log of the borehole, indicating drilling and casing diameters and depth, formation stabiliser inserted, grouting and completion details
- A hydrogeological log of features important to groundwater occurrence, including weathering depth, fracturing, wad, fissures, cavities, karst and information concerning depth of water strikes and blowing yield, lost circulation, and
- Signature for measured quantities agreed on site with the driller.

It is often necessary to test exploratory/monitoring boreholes to obtain information on aquifer hydraulic parameters and groundwater quality. Testing should be undertaken by an experienced contractor in compliance with the required technical specifications. The Water Manager/ Hydrogeologist will ensure that the appointed contractor has signed the relevant technical specifications.

Field operations should be undertaken under the supervision of the Hydrogeologist appointed by the Water Manager to ensure that the boreholes are tested in accordance with the required specifications. The supervisor will sign for measured quantities agreed on site with the testing contractor.

Water samples should be collected from newly-drilled exploratory/monitoring boreholes according to the protocols outlined in Appendix C in order to provide data to supplement that collected during the hydrocensus. This data is used to determine prevailing groundwater quality across the aquifer(s) within the catchment.

NOTE:

Forms for capturing data are included in Appendix B.

Technical details concerning the testing of boreholes (both quantity and quality) are included in Appendix C. The Water

Manager/Hydrogeologist must ensure that the procedures described in Appendix C are adhered to.

Step 6: Prepare conceptual groundwater model

The conceptual groundwater model is prepared using the data and information collected during the previous steps. Essentially, the desktop study report is updated with this new information in accordance with the model Table of Contents in Appendix D1.

In essence, the conceptual model describes the lithological composition of the aquifer, presence or absence of low permeability formations, aquifer boundaries, compartmentalising of the aquifer, fractures and faults, degree of weathering, distribution of karst features, presence or absence of surface water bodies, springs and seepage zones, recharge potential, and distribution of water levels. The model must incorporate existing abstraction and land use (e.g. irrigation, mine waste dumps), since these have an impact or may have an impact on the available sustainable resources of the aquifer.

The model constitutes the conceptual level understanding of the aquifer and its behaviour, and provides the basis for future decision-making.

Step 7: Risk assessmentProximity to existing boreholes

In order to minimise interference between adjacent boreholes, new abstraction boreholes in aquifers should not be drilled close to any existing borehole. Recommendations concerning the minimum distance will form one of the conclusions of the assessment study. The minimum distance can vary significantly and depends on many factors, such as the type of aquifer (karst, fractured, weathered) and permeability of the aquifer. Where a group of boreholes are drilled to form a well-field, distances should be determined by the findings of the detailed hydrogeological survey.

Minimising the risk of pollution from nearby sources of contamination

In general, no water use borehole drilled in an aquifer should be located within a minimum distance of potential sources of contamination, including:

- Pit and Ventilated Improved Pit (VIP) latrines
- Animal kraals
- Effluent discharges from chicken hatcheries and piggeries
- Dip tanks
- Cemetery/graveyard/burial site
- Mine tailings dams, waste disposal sites, or
- Any other source, or potential source, of contamination.

Recommendations concerning the minimum distance will form one of the conclusions of the assessment study. The minimum distance can vary significantly and depends on many factors, such as the type of aquifer (karst, fractured, weathered), permeability of the aquifer, vulnerability of the aquifer and type of contaminant source.

Water use boreholes should always be located up-gradient of a current or potential source of groundwater contamination. They should not be drilled within the floodline of a drainage channel, as these areas are prone to flooding.

NOTE:

Valuable information on various contamination risks is available in the DWAF/NORAD, 2004 document, Section 3.4: Guidelines on protecting groundwater from contamination, especially with regard to water sources and sanitation.

Step 8: Spring capture and surface water - groundwater interaction

Springs can be considered as an optional source of water to satisfy water requirements. Depending upon their yield and reliability, they can be used as stand-alone sources or in conjunction with abstraction boreholes. Springs are often vulnerable to significant variations in flow, and low-flowing springs often dry up completely during periods of drought.

Various methods of spring capture are available, ranging from small impoundments to weirs to large dams. Each method of capturing spring flow should provide protection to maintain the (pristine) water quality and impoundment.

Spring capture must involve the following considerations:

- Accurate determination of spring flow
- Seasonal/cyclic fluctuations
- Recharge to the spring flow
- Reserve requirements
- Protected areas e.g. indigenous species
- Current downstream use of spring flow
- Impact of current abstraction in the catchment/compartiment contributing to the spring flow
- Impact of impoundment on wetlands
- Impact of impoundment on surface flow
- Surface water - groundwater interaction, and
- Contribution of groundwater systems to streams, rivers and wetlands.

NOTE:

Further details for spring data and classification are available in the Standard Descriptors for Geosites, DWAF/NORAD, 2004.

Step 9: Present to stakeholders and obtain input

Present the outputs of the assessment of water availability and water requirements to the relevant stakeholders to obtain comment and feedback. The relevant stakeholders will have been identified as part of the public participation process (refer to Section 0).

Step 10: Prepare numerical/analytical/risk-based groundwater model

For some assessments, particularly at the site-specific level, it may be desirable or necessary to prepare a numerical, analytical or risk-based model of the aquifer.

Where a model is prepared, predictions of the long-term behaviour of the aquifer under the planned development can be made, and simulations of certain aspects being investigated, such as migration of pollution plumes with time, can be undertaken. Once the model has been finalised, this can be used as input to risk-based decision-making.

Various modelling packages can be selected for numerical modelling, the most common being Modflow, a three-dimensional finite difference modelling package, and FeFlow, a three-dimensional finite element modelling package.

Numerical modelling is highly specialised and will require the services of a modelling expert to advise on modelling requirements, capabilities and limitations, and to prepare and run the model. It must be noted that numerical modelling of aquifer systems have high data requirements, because of the 3D nature of the system and will thus only be effective where sufficient 3D information is available.

Step 11: Prepare Assessment Report

From the above assessments and consultation, identify issues with respect to IWRM and areas where the water balance indicates that there are current or potential water shortages. Possible water use options to meet current or future water requirements should also be identified. The Assessment Report will draw conclusions on the groundwater resources and applicable technical information. These conclusions will assist in guiding the planning process (see Section 2.2.5).

Finalise the assessment report detailing the conclusions reached and inputs for the planning phase. The report will include maps, borehole logs, test pumping data, water quality assessment, aquifer assessment and classification, protection zones, RDM requirements, and the delineation of potential target areas, as applicable.

NOTE:

A generic Table of Contents for the Assessment Report is included in Appendix D.1.

2.4.4 Other Specialist Studies

The Water Manager must therefore consider all the above aspects when undertaking assessment, planning and management of the groundwater resources in the catchment. Accordingly, specialist studies may be required in support of any planned development of the aquifer to confirm the ability of the aquifer to deliver the required water use, and to identify and quantify impacts. Such studies could include:

- Feasibility of implementing artificial recharge
- Identification of groundwater-dependant ecosystems (Colvin *et al*, 2003)
- Direct, indirect or unique/keystone ecosystems
- Determination of sensitivity of the landscape to fluctuations in water levels and resultant ground subsidence or sinkhole formation, and
- Assessment of existing or planned infrastructure that may be affected.

These studies will require the appointment of specialist consultants and would normally form part of an overall assessment of the groundwater resources at a catchment or WMA level.

NOTE:

Additional information on groundwater protection is available in the DWAF/NORAD, 2004 document: Guidelines for protecting springs.

2.5 Planning

2.5.1 What is meant by planning?

Planning within IWRM is a process of matching water availability with water requirements. Planning typically involves the investigation of development options to meet water requirements through a predetermined sequence of increasingly detailed phases. Planning generally follows an assessment during which the various water development options (including groundwater options) are identified. Planning ensures that the information is made clear to the decision-maker.

2.5.2 Why is planning important?

The planning function is important because:

- It provides the rules and guidelines to enable sustainable use of the water resource, or recommends the use of existing guidelines
- It provides the “bigger picture” within which the water resources can be managed, both current and future, and
- It provides the motivation for funding for the implementation of a particular water development option.

2.5.3 Framework for water resource planning

Water resource planning is undertaken within the framework of integrated water resource planning (IWRP) and integrated water resource management (IWRM). These integrated processes include the sustainable utilisation of water resources and the equitable distribution of water. They acknowledge that groundwater is an important and integral part of South Africa’s water resources and its use should be planned and managed accordingly.

The Department has identified five core strategies to promote the successful implementation of IWRM in South Africa:

Groundwater must be integrated into the management of water resources for the benefit of all the people of South Africa

- Groundwater needs to be promoted so that water resource managers, water users and the public are more aware of the role, occurrence and value of groundwater
- Hydrogeologists need to be encouraged and enabled to work outside their line function and to be integrated in broader water resource planning and management functions
- A larger, skilled and experienced specialist hydrogeological workforce is required, and
- Groundwater monitoring and the development of a hydrogeological information system are required to assist in the provision of data and information to those who need it.

2.5.4 National level planning: Methodology and details

National level planning is undertaken at a reconnaissance level. It is an initial exploratory study that provides a preliminary examination of an area, and includes a desk-top evaluation of the water use options to meet particular requirements.

Figure 2.6 summarises the steps involved in a national (reconnaissance) level planning study. The steps are described in more detail in the following sections. The inputs into the study are:

- The recommendations from the national level assessment, and

- Details of the Resource Quality Objectives, set during a public participation and planning process. The technical contribution for the integrity of the resource will be concluded in the assessment process and used as input.

NOTE:

The GRDM training manual (WRC project 1427), available from the Departments RDM office, provides additional details on setting the Reserve and Resource Quality Objectives.

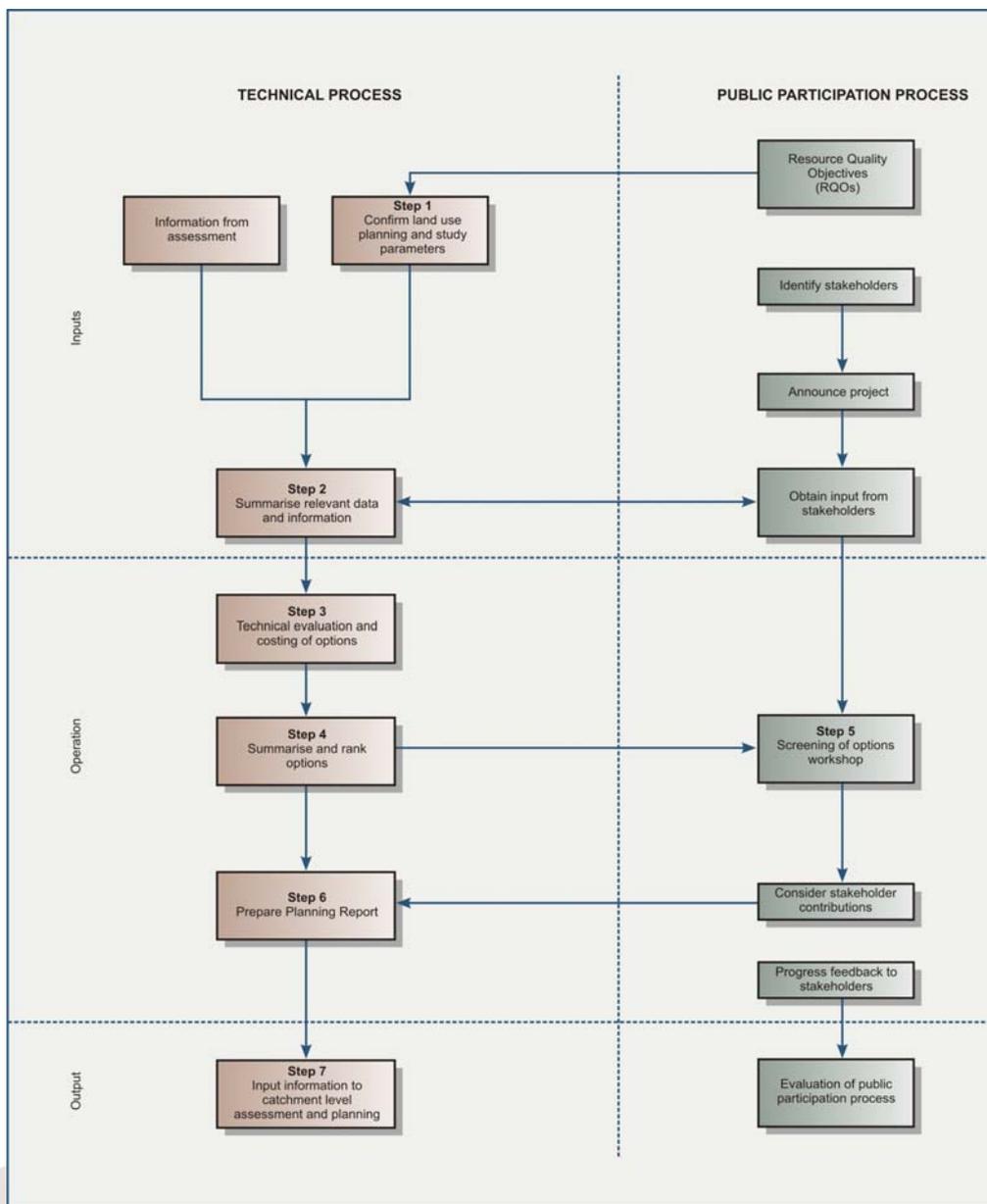


Figure 2.6: Process for national (reconnaissance) level planning

Step 1: Confirm land use planning and study parameters

In general, information on land use planning and the study parameters will be determined during the assessment phase. During this step, confirm:

- Land use planning for the study area, particularly in and around the target aquifer
- Requirements for water, including :
 - Likely geographic location for the requirements
 - Quantity of water required (m³ per month)
 - Specifications on the quality of the water required, or any water quality constraints to be included in the planning process, and
 - The required assurance of use (i.e. the percentage of time in any given month that the water is required)
- Proposed water use options.

Step 2: Summarise relevant data and information

Summarise all available data and information on the water development options, as obtained during the assessment process, including:

- All existing Departmental and external reports and databases pertaining to the water use options
- Information from the national level assessment, and
- Details of the conceptual layout for the various water use options.

Step 3: Technical evaluation and costing of options

Evaluate the water use options at a preliminary level, including a desk-top assessment of the technical feasibility of the options, preliminary costs and potential fatal flaws. Only limited verification and field work should be required. This evaluation will thus be at a low level of accuracy and will include conceptual-level design input to address the following issues:

- Can the target aquifer meet water requirements on a sustainable basis (technical feasibility)?
- Technical details of each option and are these broadly acceptable
- Cost analysis of the various options
- Comparison of options, and
- Elimination of options with fatal flaws.

Step 4: Summarise and rank options

Summarise and rank the water use options in a format that can easily be presented to the stakeholders such that the stakeholders can make informed decisions.

Step 5: Screening of options workshop

Present the proposed water use options to stakeholders at a national and regional level to obtain information on fatal flaws and/or consensus on the perceived feasibility of the various options. This will take the form of workshops and focussed discussions. The relevant stakeholders will have been identified as part of the public participation process (refer to Section 0).

Step 6: Prepare Planning Report

Summarise the relevant information from the technical and public participation process into one report. This report will provide recommendations on which options can be taken forward to the catchment level (pre-feasibility) planning study.

NOTE:

A generic Table of Contents for the Planning Report is included in Appendix D.2.

Step 7: Input information to catchment level assessment and planning

The information gathered during the national level planning process should feed into the catchment level assessment and planning processes. This will form the most basic information necessary to feed into a Catchment Management Strategy for the area.

2.5.5 Catchment Level Planning: Methodology and Details

Catchment level planning is undertaken to a pre-feasibility level and is a precursor to the feasibility level study. The pre-feasibility planning study will require a level of field work that secures accurate information and data, and often requires considerable verification of aspects such as sustainable development, potential impacts, the technical feasibility and cost. This study is thus preceded by catchment level assessment and national level planning to obtain the necessary information to minimise the options to be evaluated at a pre-feasibility level.

A risk assessment of likely impacts of any proposed development will form part of the planning process.

Figure 2.7 summarises the steps involved in a catchment (pre-feasibility) level planning study. The steps are described in more detail in the following sections. The input into the process comprises the information from the national level planning process and the catchment level assessment.

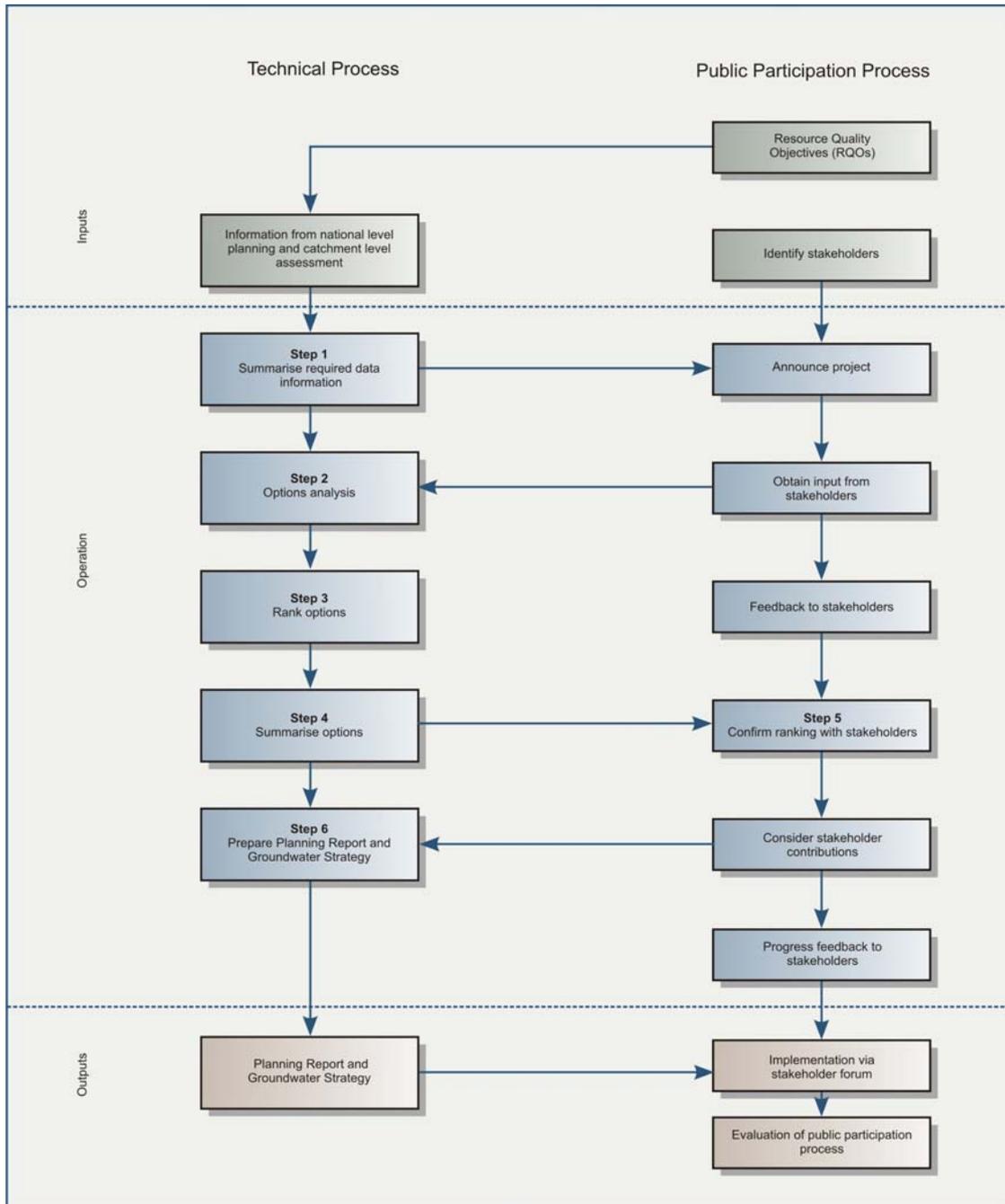


Figure 2.7: Process for catchment (pre-feasibility) level planning

Step 1: Summarise required data/information

Obtain the information and recommendations from the national level planning and catchment level assessment processes that are required for planning, design and costing purposes in the catchment level planning process.

Step 2: Options analysis

Undertake sufficient pre-feasibility level design and costing to be in a position to assess the various water use options. Each option should be assessed on the basis of: a) social considerations, b) potential environmental impact, c) economic and financial viability, d) technical feasibility, e) long-term land use, and f) regulatory considerations.

Step 3: Rank options

Rank the water use options using the results of the assessment from Step 2. Figure 2.8 and Figure 2.9 provide examples of an evaluation tool that can be used to rank the options at a pre-feasibility level.

		Consequence of success											
		Social	Environmental	Economic	Technical	Long-term land -use	Regulatory						
Probability of success	1	1	2	3	4	5	1	No benefit to local community	Very high environmental impact	Very high cost	Not sustainable	No beneficial impact on land-use	Very difficult passage through regulatory requirements
	2	2	4	6	8	10	2	Limited benefit to local community	High environmental impact	High cost	Limited sustainability	Limited beneficial impact on land-use	Difficult passage through regulatory requirements
	3	3	6	9	12	15	3	Some benefit to local community	Medium environmental impact	Average cost	Short-term sustainable	Some beneficial impact on land-use	Some difficulties with regulatory requirements
	4	4	8	12	16	20	4	Large benefit to local community	Low environmental impact	Low cost	Medium-term sustainable	Large beneficial impact on land-use	Easy passage through regulatory requirements
	5	5	10	15	20	25	5	Significant benefit to local community	Very low environmental impact	Very low cost	Long-term sustainable	Significant beneficial effect on land-use	Very easy passage through regulatory requirements
	1	2	3	4	5								
	Very Low	Low	Medium	High	Very High			STRATEGIC ASSESSMENT MATRIX					

KEY	
	Highly undesirable
	Medium desirability
	Highly desirable

Figure 2.8: Strategic assessment matrix for water use options

Assessment of short-listed water supply options																	
OPTION	Weighting	1		2		3		4		5		6		7		8	
		Water supply Option #1		Water supply Option #2		Water supply Option #3		Water supply Option #4		Water supply Option #5		Water supply Option #6		Water supply Option #7		Water supply Option #8	
Evaluation criteria		Consequence	Probability														
Social	1	2	2	2	2	2	2	4	4	4	4	3	2	5	4	2	2
Environmental	1	2	2	2	2	2	2	4	4	4	4	3	2	5	4	2	2
Economic	1	2	2	2	2	2	2	4	4	4	4	3	2	5	4	2	2
Technical	1	2	2	2	2	2	2	4	4	4	4	3	2	5	4	2	2
Long-term land use	1	2	2	2	2	2	2	4	4	4	4	3	2	5	4	2	2
Regulatory	1	2	3	3	3	2	3	4	4	4	4	4	4	4	4	2	4

EVALUATION OF OPTIONS	Water supply Option #1	Water supply Option #2	Water supply Option #3	Water supply Option #4	Water supply Option #5	Water supply Option #6	Water supply Option #7	Water supply Option #8
	Social	4	4	4	16	16	6	20
Environmental	4	20	4	12	16	20	16	16
Economic	6	6	6	12	6	12	9	9
Technical	4	16	20	12	12	16	16	8
Long-term land use	4	6	4	9	16	6	6	9
Regulatory	6	9	7	16	16	16	16	8
Average	4.7	10.2	7.3	12.8	13.7	12.7	13.8	9.0
Highly undesirable	1 to 3							
Medium desirability	4 to 11							
Highly desirable	12 to 25							
Ranking	8	5	7	3	2	4	1	6
Fatal flaw assessment	acceptable							

Figure 2.9: Pre-feasibility level screening of options

Step 4: Summarise options

Summarise the water use options in terms of technical feasibility, economic and financial viability and potential environmental impact. The summary of water use options should be presented in a manner that enables the stakeholders to make informed decisions.

Step 5: Confirm ranking with stakeholders

Arrange interaction meetings and presentations with stakeholders at which the results of the ranking process and the pre-feasibility level designs and cost estimates can be discussed with the stakeholders and consensus reached on the options that should be pursued.

Step 6: Prepare Planning Report and Aquifer Strategy

Use the results of the previous steps to recommend the water use options to be taken to the feasibility level stage and prepare the Planning Report. This information will typically feed into the Catchment Management Strategy for an area.

NOTE:

A generic Table of Contents for the Planning Report is included in Appendix D.2.

2.5.6 Site-specific planning: Methodology and details

Site-specific planning is undertaken at a feasibility level. The feasibility level planning study is an intensive investigation and optimisation of the most beneficial layout of the scheme under investigation, resulting in the best layout of the scheme and its major dimensions and final specifications. This study will provide sufficient information to enable detailed design of the preferred scheme.

The feasibility level planning study is preceded by a detailed assessment of the feasible options at the site-specific level. The assessment will include siting, drilling and testing of boreholes, and then using this information to derive a conceptual hydrogeological and, if necessary and applicable, a numerical model of the aquifer.

The requirements of the Environment Conservation Act (Act No. 73 of 1989) in respect to Environmental Impact Assessments (EIA) must be understood and adhered to as necessary. The National Environmental Management Act (NEMA) (Act No. 107 of 1998) contains details specifying which proposed activities require an EIA, and to what level this should be undertaken. This is in addition to any licence application that may be required for the proposed use from the Department of Water Affairs and Forestry or the CMA.

Figure 2.10 summarises the steps involved in a pre-feasibility level planning study. The input to the process includes the information from the catchment level planning and site-specific assessment processes. The steps in the site-specific planning process are described in more detail in the following sections.

NOTE:

Additional information is available in the DWAF/NORAD, 2004 document, Section 7.2: Introductory guide to appropriate solutions for water and sanitation and Section 7.3: Decision-making framework for Municipalities.

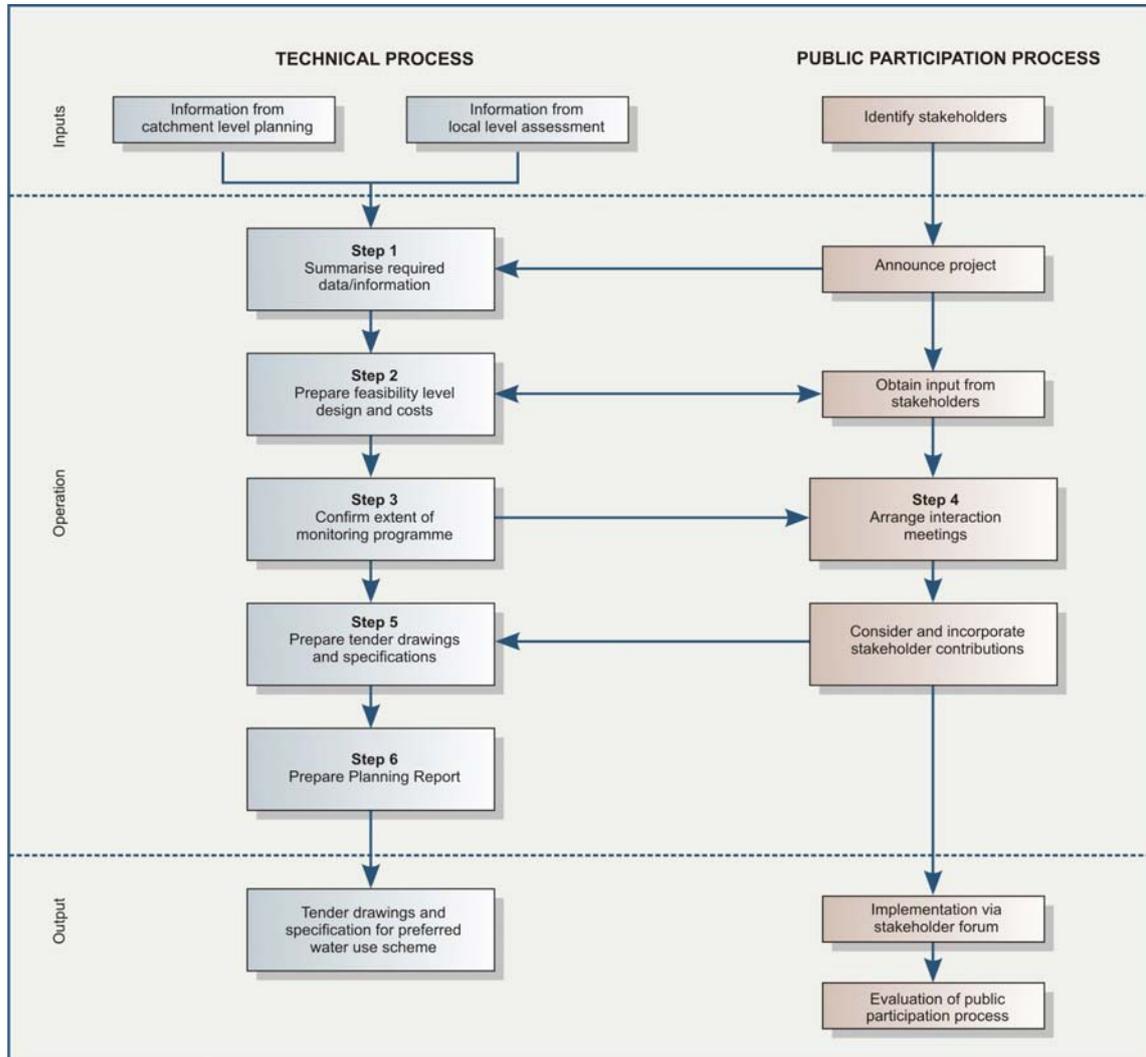


Figure 2.10: Process for site specific (feasibility) level planning

Step 1: Summarise required data/information

Obtain the information and recommendations from the national level planning and catchment level assessment processes that are required for planning and design purposes in the site-specific level planning process.

The EIA requirements applicable to the proposed project must be confirmed and EIA approval must be obtained from the relevant provincial environmental office, where required. It is important to note that obtaining a Record of Decision may take several months for a large development project, and sufficient time must therefore be allowed for this process.

NOTE:

Further information concerning the EIA process and requirements can be found in Environment Conservation Act (Act No. 73 of 1989)

Step 2: Prepare feasibility level design and costs

The design team will prepare the feasibility level drawings and specifications, and the associated costs, for the preferred water use options. The team will submit these drawings, specifications and costs to the Water Manager for approval.

The feasibility level design will include an optimisation of the various elements of the preferred water use option, including:

- Configuration and design of water use/monitoring boreholes
- Layout and routes for the water collection and distribution system
- Design of water use pipelines (diameter, wall thickness, etc)
- Material specifications for pipelines storage systems etc, and
- Detailed assessment of the likely impact of implementing the preferred water use scheme, waste dump and/or other land use option on the integrity of the aquifer (quantity and quality).

NOTE:

The production boreholes required for the feasibility level design will be positioned following a risk assessment.

Step 3: Confirm extent of the monitoring programme

The monitoring programme and plan will be prepared during the planning process, incorporating:

- Objectives to be met in the monitoring programme
- Location of the monitoring points, and
- Frequency of monitoring that should occur and constituents to be analysed.

Confirm the extent of this monitoring programme with the relevant role-players.

Step 4: Arrange interaction meetings

Arrange interaction meetings and presentations with stakeholders to present and discuss the design details and costs associated. Incorporate comments and suggestions from the stakeholders in the final reporting.

If at this stage, the preferred option under investigation has a fatal flaw or is too costly, the process stops and another option is investigated.

Step 5: Prepare tender drawings and specifications

The design team will prepare the tender drawings and specifications for the preferred water use option. This will include the following details:

- Final design, positioning and drilling of the water use boreholes
- Pumping tests of the boreholes to confirm yields
- Drilling plan for monitoring boreholes
- Construction plans for water collection and distribution pipelines
- Construction plans for water storage systems, if applicable
- Details of construction cost estimates
- Proposed construction programmes, including milestone and target date(s) to completion
- Budget for the preferred scheme, and
- Implementation Plan for the preferred scheme.

The team will submit these drawings, specifications and costs to the Water Manager for approval. Examples of generic technical specifications and drawings are included in Appendix D. These can be used by:

- The Water Manager as a guide for inclusion in tender documents for the specific work, and
- The field Hydrogeologist to ensure adherence and compliance by the contractor.

NOTE:

Additional information is available in the relevant Water Service Development Plans (WSDPs), Integrated Development Plans (IDPs) for the area and Provincial Spatial Development Frameworks.

Step 6: Prepare Planning Report

Prepare the Planning Report. This will include a recommendation for the preferred option for implementation.

NOTE:

A generic Table of Contents for the Planning Report is included in Appendix D.2.

2.6 Management**2.6.1 What is meant by Management?**

Management of groundwater resources relates to the sustainable use and development of these resources. It focuses on the sustainable development of the groundwater resources without compromising resource integrity (quantity and quality). Management thus involves monitoring quantity and quality over a long-term period and the use of this information to determine compliance against set goals and to assess whether the strategic goals of the Department are being met.

Management is generally an iterative process that has two components:

- Setting management objectives, including strategic objectives set at a national level, the catchment management strategy (CMS) and management plans set at catchment and site-specific levels, and
- Monitoring and reporting against these objectives, as well as updating the strategies and management plans on an ongoing basis.

Monitoring and reporting will provide information to assess the operations against the strategic goals and objectives (compliance assessment). The results of the compliance auditing will be used to devise action plans and update the strategic goals, if required.

2.6.2 Why is Management Important?

The management function is important because it provides:

- A continuous record of the response of the aquifer to various inputs and outputs, including recharge, base flow, impacts, evapotranspiration, etc
- A tool to confirm the continued suitability of the aquifer for the specific water use purposes. Monitoring measures groundwater information continuously and can detect reduced yields and the induced inflow of poorer quality water
- Information for the characterisation of the aquifer on a regional scale

- Information for use by the Water Manager in the integrated management of the water resource to ensure sustainability, including the need for and scoping of intervention strategies
- Information for future decision-making and planning, and
- Feedback to the planning and assessment processes.

2.6.3 National Level Management: Methodology and Details

National level management entails setting strategic goals, developing policies and strategies for implementation at regional level, reviewing catchment level performance against set management goals and giving support to CMAs in preparing/updating management plans to ensure ongoing compliance with the strategic goals.

National level management includes the following aspects:

- Auditing performance against NWRS objectives
- Overview of the national water quantity and quality monitoring system through monitoring ambient trends, including surface and groundwater data
- Preparing particular strategies for the management of water resources, for example:
 - Utilisation of the storage of the resource during drought periods. This would involve drawing the water at levels below the normal management level in order to use the storage. This would then be rapidly recharged during subsequent periods of high rainfall, in a manner akin to a surface water dam
 - Setting operational rules for the sustainable utilisation and management of the aquifers (e.g. maximum discharge volumes, normal operation base water level, drought operation base water level), and
 - Establishing guidelines for artificial recharge where this may be feasible (i.e. when a suitable source of surplus water exists). Such a strategy will require a thorough assessment of the aquifer and of the quality of the source water before implementation
- Water Conservation/Water Demand Management and optimising the system potential
- Preparing strategies for land use management (e.g. in relation to urban and industrial development and positioning of waste disposal facilities), and
- Management of strategic issues such as inter-catchment resources and international obligations.

The Policy & Regulation Branch in the Department's National Office will be responsible for the national level management process.

Figure 2.11 summarises the steps involved in national level management. The inputs to national level management include the strategic management objectives and management reports from catchment level.

The steps in national level management are described in more detail in the following sections.

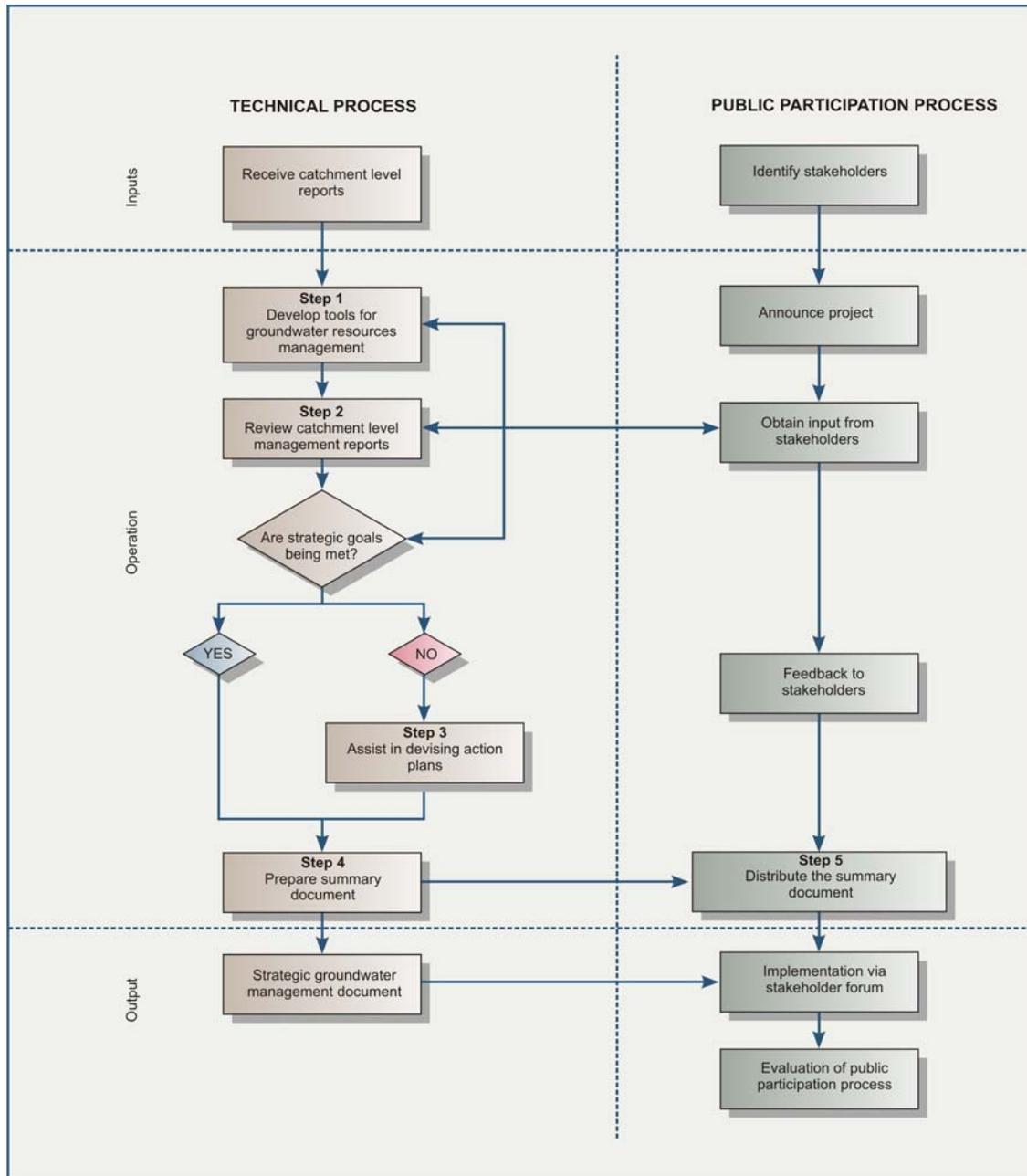


Figure 2.11: Process for national level management

Step 1: Develop tools for groundwater resources management

The groundwater resources control mechanisms for water use in a catchment will include:

- Guidelines for water use and allocation
- Guidelines for water use authorisations
- Waste discharge charges and water pricing, and
- The Groundwater Strategy.

NOTE:

Further information concerning water use authorisations is available from the Department: Water Affairs and Forestry website: www.dwaf.gov.za.

Step 2: Review catchment level management reports

Review the information received in management reports against the catchment level RQOs and strategic goals. This assessment will review whether or not the strategic goals of the Department are being met.

Step 3: Assist in devising actions plans

In the event that the Department's strategic goals for management of the groundwater resources are not being met, the Department's National Office personnel will advise and assist Water Managers in devising action plans to be implemented at catchment level. These action plans should ensure that future actions are aimed at meeting these goals.

Step 4: Prepare summary document

Prepare a strategic management and review document summarising:

- Performance during the previous reporting period against the strategic goals
- Areas where performance goals have been achieved
- Areas where performance improvements are required
- Performance goals for the next reporting period, and
- Strategies and action plans to achieve future performance goals.

Step 5: Distribute the summary document

Distribute the strategic summary document to all relevant managerial role-players in the Department for comment and sign-off. The Department may also wish to publish these documents for wider use and comment.

NOTE:

Further information concerning water quality components is available in the Water Quality Management Series published by DWAF in March 2003, Sub-Series No. MS 8.1, MS 8.2 and MS 8.3, Edition 1.

2.6.4 Catchment level Management: Methodology and Details

Catchment level management includes, among other functions, the following components:

- Monitoring cumulative impacts on aquifer systems and data management
- Refining the control mechanisms for the management of water use, including operational rules for aquifer utilisation and procedures for combating over-exploitation of the dolomitic aquifer resources, and
- Assessment of the aquifer behaviour as result of impacts imposed against the RQOs
- Auditing the compliance of water use against licensing conditions
- Reporting to both the national and site-specific levels, and
- Feedback to the water users.

The Water Manager will be responsible for the catchment level management function.

Figure 2.12 summarises the steps involved in catchment level management. The inputs to the process include the details from the site-specific management function. The steps in catchment level management are described in more detail in the following sections.

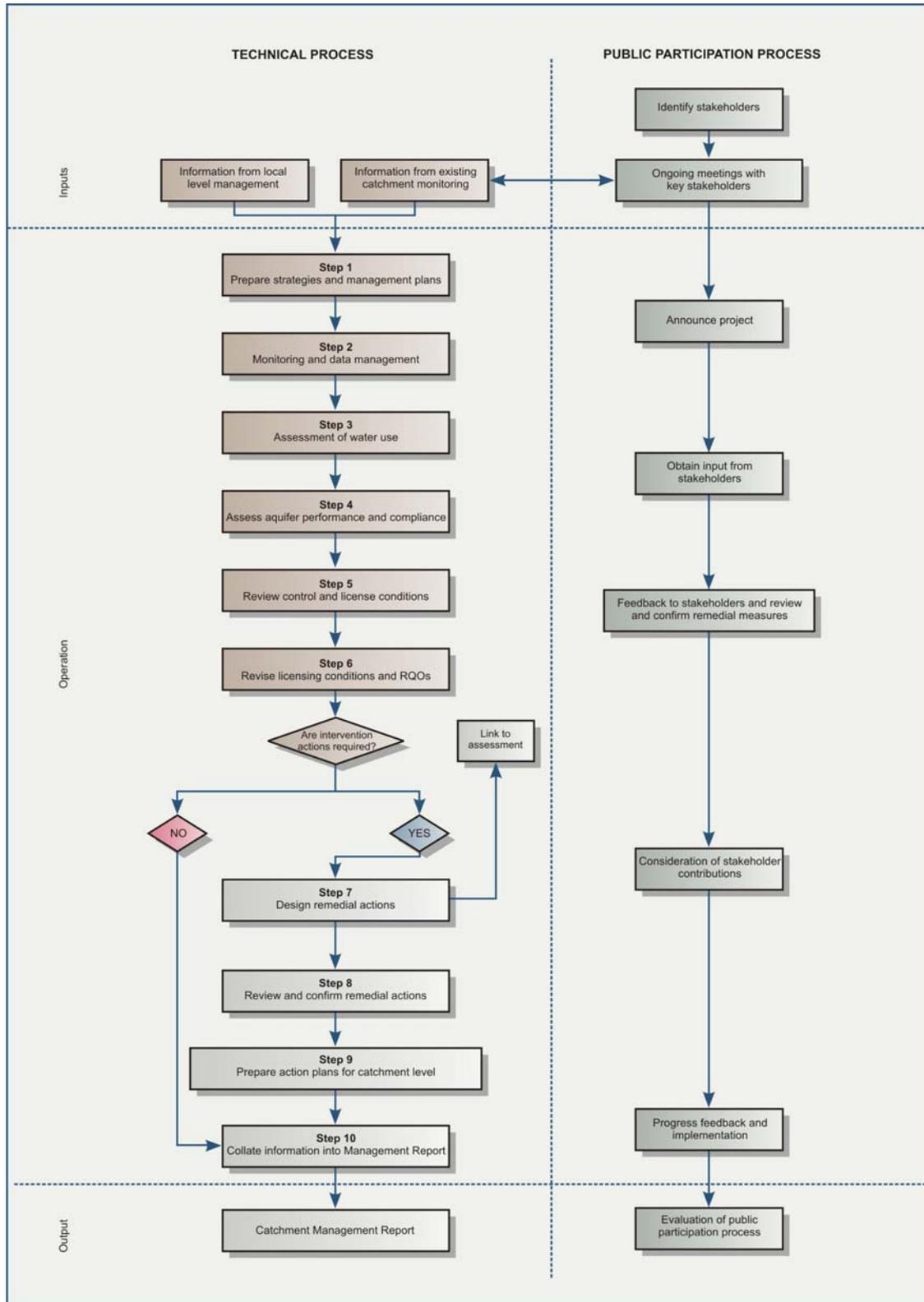


Figure 2.12: Process for catchment level management

Step 1: Prepare strategies and management plans

Prepare and/or update the Integrated Water Resources Management (IWRM) plan for use by the Water Manager and CMA personnel in the management of the catchment. This will provide the strategic direction and performance targets for the operational personnel for the next reporting period.

NOTE:

A generic Table of Contents for the IWRM Plan is included in Appendix D.3.

NOTE:

Further information is available in Integrated Water Resources Development Plans, Training Manual and Operational Guide (CIDA) and Water Quality Catchment Assessment study and Catchment Management Strategy Guidelines.

Step 2: Monitoring and data management

Correct data management forms the basis for sustainable water management and is thus an essential component of the overall monitoring and management programme for the groundwater resources of dolomitic aquifers.

Further details on monitoring and data management are provided in site-specific management (**Section 2.0**).

Step 3: Assessment of water use

Assess the report received from the site-specific management process against the licensing conditions. Record water management performance within the catchment and any occurrences of non-compliance.

Step 4: Assess aquifer performance and compliance

Assess the monitoring data from catchment level monitoring networks against RQOs. Assess the water abstraction, water level response and water quality trends for the monitoring period. Determine aquifer behaviour against management objectives and assess aquifer performance.

On the basis of the monitoring data, determine the compliance and need for the implementation of any remedial actions.

Step 5: Review the control and license conditions

The groundwater resources control mechanisms for water use in a catchment are developed during the national level management process, and include guidelines for water use and allocation, guidelines for water use authorisations and waste discharge charges and water pricing. Licensing conditions are based on these control mechanisms and the RQOs set for the catchment. The control mechanisms and licensing conditions should be reviewed at a catchment level, based on:

- The catchment level strategies and management plans set in Step 1
- The information provided from the existing catchment monitoring
- The aquifer performance, and
- Water use compliance.

Step 6: Revise licensing conditions and RQOs

Revise the existing license conditions and RQOs for the catchment, based on the review undertaken in Step 5.

NOTE:

*Further information is available in
Parsons, R, Wentzel, J.(2006) GRDM
Manual. WRC Project 1427.*

Step 7: Design remedial actions

Together with the Hydrogeologist and design team, the Water Manager will either notify the water user of the required remedial measures, or will design these measures for implementation by the water user. The Water Manager should ensure that these measures are correctly implemented.

Step 8: Review and confirm remedial actions

Present the proposed remedial actions to the relevant role-players, obtain input and update the remedial actions accordingly.

Step 9: Prepare actions plans for catchment level management

Prepare detailed action plans for use by the Water Manager and CMA personnel for the implementation of the remedial actions. This will include monitoring frequency, well-field and borehole operational procedures and land use management.

Step 10: Collate information into Management Report

Collate all information collected and reviewed at the catchment level into a Management Report for use by the Policy and Regulation Branch of the Department's Head Office in the national level management process.

2.6.5 Site-specific Management: Methodology and Details

Site-specific management includes the following tasks:

- Collection, collation, storage and assessment of monitoring data within, and surrounding the water use(s)
- Implementation of water development options identified as part of the planning process
- Supervision, or implementation, of the remedial measures identified as part of the monitoring and management function
- Operation and maintenance
- Control of specific water uses, and
- Reporting.

NOTE:

Information on site-specific groundwater management is available in the NORAD toolkit, as follows:

Section 1.1: A framework for groundwater management of community water supply

Section 1.2: Implementing a rural groundwater management system

Section 7.1: Sustainability Best Practices, Guidelines for rural services.

The water user (e.g. Local/District Municipality, WUA, mine, industry or delegated personnel) will be responsible for site-specific management.

Figure 2.13 summarises the steps involved in site-specific management. They are described in more detail in the following sections.

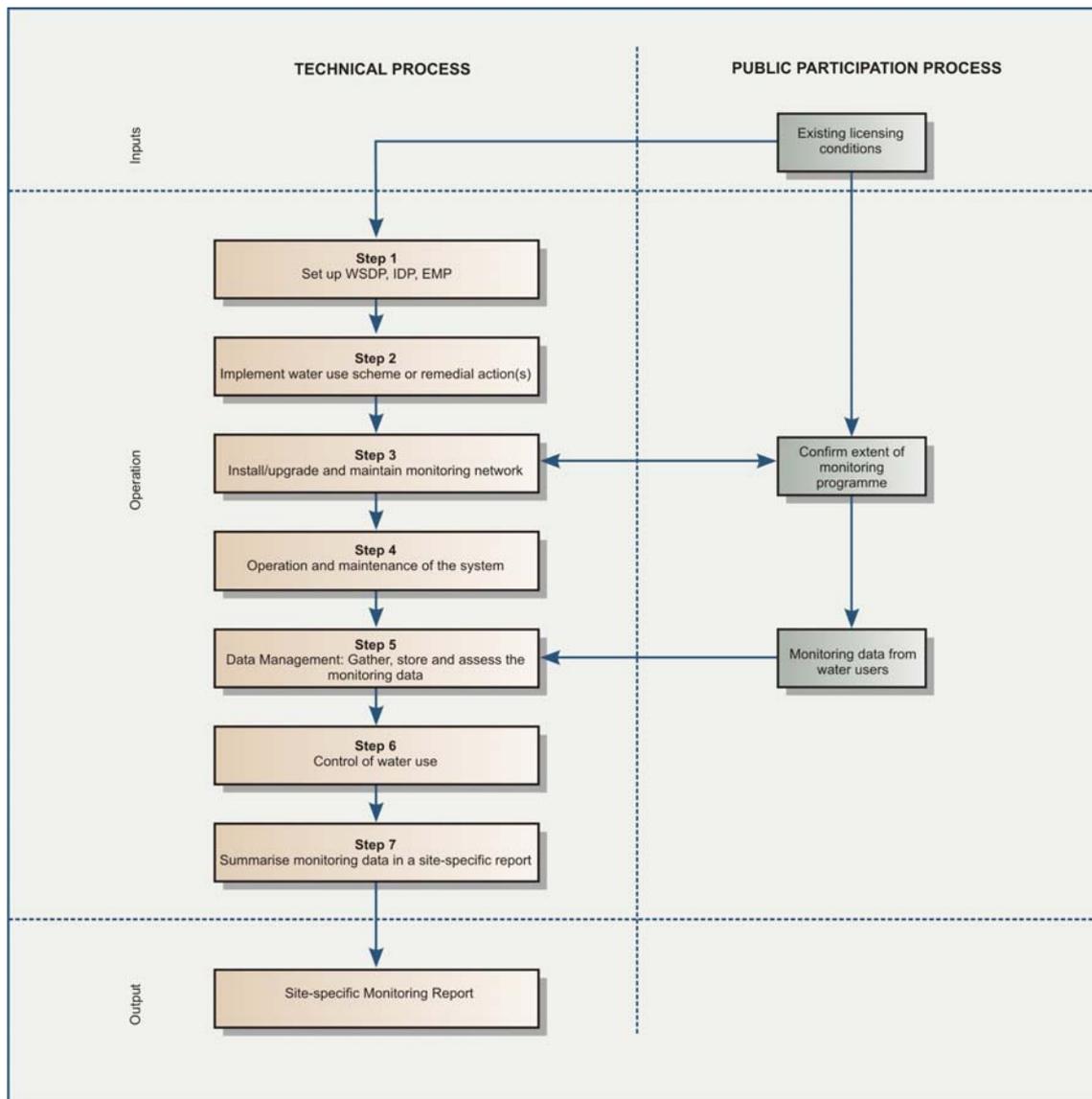


Figure 2.13: Process for site-specific management

Step 1: Set up WSDP, IDP, EMP

The Water Manager/Hydrogeologist will, together with the relevant personnel from the local municipalities, develop/update the groundwater aspects of the local WSDP and IDP as well as the Environmental Management Plan (EMP) for any new water use. This will take into consideration any information available from the catchment planning phase.

Step 2: Implement water use scheme or remedial action(s)

Implement approved site-specific schemes and actions, including:

- The preferred water use schemes as identified during the planning process and specified in the Planning Report, and
- Any remedial measures that have been recommended from the catchment level management function.

NOTE:

Additional information is available in “Minimum Standards and Guidelines for Groundwater Resource Development for the Community Water Supply and Sanitation Programme”.

Step 3: Install/update and maintain monitoring network

Ensure that the monitoring network installed during the implementation phase is sufficient to provide effective coverage and accurate measurements for management purposes. This includes abstraction well-fields and their monitoring boreholes, local and regional monitoring network, monitoring boreholes around individual facilities, such as sewage works, waste dumps, etc, and springs.

The monitoring network should include:

- Weather station within the study area
- In-line flow meters for monitoring water abstraction from boreholes
- Piezometer tubes to measure water levels in pumping holes at the end of a non-pumping cycle; alternatively, install continuous water level monitoring equipment, and
- Borehole sampling to monitor quality of groundwater
- Spring flow measurements, and
- Sampling of spring flow to monitor water quality

The monitoring network must be regularly maintained.

Step 4: Operation and maintenance of the system

The Water Manager, Hydrogeologist and other relevant personnel will ensure that the well-field for water use and the monitoring system is correctly operated and regularly maintained.

Step 5: Data Management: Gather, store and assess the monitoring data

Correct data management forms the basis for sustainable water management and is thus an essential component of the overall monitoring and management programme for the groundwater resources of dolomitic aquifers. Data management involves correct data collection, recording, handling, archiving and reporting according to an agreed data management system.

Data collection should be managed as part of a value chain. This value chain includes (a) *data* acquired from the monitoring system (b) *information* generated, based on this monitoring data (c) *knowledge* and insight to resolve questions (d) *strategic* and/or *operational decisions*, and (e) the organisation's *mission and objectives*. The mission and objectives of an organisation clearly provide a long-term focus, while data collection has a short-term focus.

NOTE:

Further details on Good Data Management can be obtained from "Good Data Management Practices" (2006), E. Bertram, DWAF report, unpublished.

When monitoring data is being collected, the various aspects described in the following sections should be considered.

Monitoring frequency

Borehole water level and abstraction monitoring should be undertaken on a routine basis, with the frequency of monitoring generally being set at monthly intervals.

In order to obtain information to guide preventative or remediation measures (if required), borehole monitoring will also be required on an incident-related basis.

NOTE:

The installation of continuous real-time monitoring equipment in key selected boreholes is highly recommended.

Water sample collection and frequency

Ensure that a representative groundwater borehole sample is obtained on a routine basis. Samples will generally be collected at six-monthly or yearly intervals. More frequent sampling may be specified where, for example, pollution of the groundwater resource is suspected.

Issues to consider during borehole sampling are:

- Purging the borehole
- Minimum container size
- Filtering
- Preservation method and sterilisation, and
- Use of an accredited laboratory.

NOTE:

Details of sampling protocol are available in: Weaver JMC, Cavé L and Talma AS (2007). Groundwater Sampling (second edition) WRC Project No. TT 303/07, Pretoria.

Details are also available in the Field Manual and Desk Manual published by the Winconsin Department of Natural Resources, PUBL-DG-037 96, September 1996.

NOTE:

Water Service Authorities can obtain additional information on monitoring water levels and flow in the DWAF/NORAD, 2006 document, Section 6.1: Groundwater monitoring for Pump Operators.

Reporting format

All data collected must be captured and should include:

- Hydrocensus data
- Drilling data
- Testing data, and
- Analytical data.

Data should be captured on standard forms and submitted to the Water Manager, the CMA personnel or the Department's regional office. Examples of standard forms are included in Appendix B.

Data handling and submission

Handling and submission details for the various required datasets are:

- Abstraction data:
 - Recorded by end user, and
 - Reported monthly or according to water use authorisation conditions.

- Water level data:
 - Recorded by end user
 - Reported monthly or according to water use authorisation conditions
 - Submitted to the Department, and
 - Automatic recorders installed in key monitoring boreholes by the Department/CMA.

- Water quality data:
 - Sample collected by end user and submitted to laboratory according to water use authorisation conditions/detailed constituents
 - Recorded on the catchment level monitoring database, and
 - Submitted for inclusion on the national groundwater archive (NGA), through the Catchment Management Report.

The Water Manager (or the CMA) must arrange for the inspection of measuring devices (e.g. flow meters).

Submit all groundwater monitoring data for storage on the national groundwater database (NGDB) and/or the NGA.

Present the monitoring data in a suitable format for assessment. This is likely to be a graphical representation which will allow the assessment of short-term and long-term trends in water level and quality. The monitoring data are also used:

- To provide insight into aquifer behaviour
- To support licensing decisions and for future water use allocations
- To calibrate the existing models
- To measure the performance of the aquifer / system against licensing conditions, and
- As a basis for intervention actions.

NOTE:

Aquimon, detailed in the DWAF/NORAD, 2006 document, is a tool specifically designed to assist groundwater managers with organising and interpreting data. Aquifer Management System (AMS) is available on www.usersupport.co.za. This tool focuses on the spatial and temporal management of aquifer systems based on monitoring data.

NOTE:

Additional information is available in the WRC report 861/1/02a: Guidelines for the monitoring and management of groundwater resources in rural water supply schemes.

Step 6: Control of water use

The monitoring data and generated information will be used to control water use within the site-specific environment.

Step 7: Summarise monitoring data in a site-specific report

Collate all site-specific monitoring data for the aquifer catchment into a monthly report, for use in the catchment management function. A report that audits the monitoring information should be prepared on:

- Status of the water use
- Performance of use against licensing condition
- Trends in monitoring information, and
- Suspected / planned change in use in the near future.

NOTE:

Water Service Authorities can obtain additional information in the DWAF/NORAD, 2006 document, Section 5.1: Sustainability Index Tool (SuSIT) for auditing of water supply schemes.