

"our blue print for survival"

National Water Resource Strategy

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water & forestry

Department
Water Affairs & Forestry
REPUBLIC OF SOUTH AFRICA

FOREWORD

The National Water Policy (1997) and the National Water Act (1998) are founded on Government's vision of a transformed society in South Africa, in which every person has the opportunity to lead a dignified and healthy life and to participate in productive economic activity.

The First Edition of the National Water Resource Strategy (NWRS) describes how the water resources of South Africa will be protected, used, developed, conserved, managed and controlled in accordance with the requirements of the policy and law. The central objective of managing water resources is to ensure that water is used to support equitable and sustainable social and economic transformation and development.

Because water is essential for human life the first priority is to ensure that water resources management supports the provision of water services - potable water and safe sanitation - to all people, but especially to the poor and previously disadvantaged.

But water can do much more than that: water can enable people to make a living. The NWRS seeks to identify opportunities where water can be made available for productive livelihoods, and also the support and assistance needed to use the water effectively.

Water is of course central to all economic activity. The NWRS provides a platform for the essential collaboration and co-operation among all departments in all spheres of government involved in economic development. It is an important input to the evolving National Spatial Development Framework, helping to provide a better understanding of the contribution that water can make to development in all departments' areas of activity.

The National Water Act has transformed the way water is controlled, from a system of rights based on land ownership (the riparian system) to a system designed to allocate water equitably in the public interest. The progressive reallocation of water to sectors of society that were previously excluded from access to water can help to bridge the divide between the first and second economies, whilst maintaining existing beneficial water uses and encouraging the greater efficiencies needed in our dry country.

This must be done in a manner that ensures that we achieve an acceptable balance between the use of our water resources and the protection of the integrity and diversity of the aquatic environment. The NWRS therefore emphasises water conservation and measures to promote greater efficiency in water use, and outlines the support and assistance that will be provided to implement them. Whilst the pricing of water use is an important instrument to promote conservation, social needs must be addressed, and the NWRS includes provisions for subsidising previously disadvantaged users.

A vital element of the NWRS is the progressive decentralisation of the responsibility and authority for water resources management to catchment management agencies and, at a local level, water user associations. These institutions, representative of water users and other stakeholders, will facilitate effective participation in the management of water resources in their areas. It will also enable the Department of Water Affairs and Forestry to move from its present multiple roles as operator, developer and regulator to become the sector leader, policy maker, regulator and monitor. The Department will lead the creation of the new institutions, which will take a number of years, and support and guide them in the execution of their tasks.

It will continue to be necessary to build new infrastructure such as dams, pumping stations and pipelines to meet increasing demands for water to improve standards of living as well as to contribute to increased economic activity. New dams and related infrastructure will further improve security against water shortages during drought periods and, with careful operation, can also provide some safeguards in downstream areas against the effects of floods. In line with government's commitment to promote investment in economic infrastructure, an indicative

programme of capital development is outlined, much of which will be funded by the users themselves. Social investment by national government will, however, still be needed, especially in rural areas to overcome the legacy of decades of deprivation. The direct economic benefits, together with the savings in social expenditures that will result from the transformation of the lives of impoverished communities, clearly justify such investments.

A proposal is mooted to establish a national agency to develop and manage nationally-important or multi-sector infrastructure, leaving the development of local infrastructure to local institutions.

The NWRS must provide an enduring framework for water resources management, but it is not a rigid master plan. Five yearly reviews provide the opportunity to re-evaluate developments in the social and economic environments and to adapt approaches to water resources management to suit changing circumstances and needs.

The development of the NWRS brings South Africa into full compliance with one of the first targets of the Johannesburg Plan of Action, adopted at the 2002 World Summit on Sustainable Development, namely to develop national water resource management plans.

Many challenges face water resource managers in ensuring that water supports the transformation of society and the economy, and neither the resources nor the time required to address them should be underestimated. However, building on the outstanding legal foundation provided by the National Water Act, the NWRS will guide the achievement of the common vision of an equitable and sustainable society.

AN OVERVIEW OF THE NATIONAL WATER RESOURCE STRATEGY

Introduction to the National Water Resource Strategy by the Minister of Water Affairs and Forestry

In the introduction the Minister highlights, among other things, the importance of water for equitable and sustainable social and economic development, and gives a summarised overview of some key aspects of the present state of South Africa's water resources.

Chapter 1 - Water policy, water law and water resources management

The relationships between the Constitution, the National Water Policy and the National Water Act are described in this chapter, together with the purposes of the National Water Resource Strategy as -

- The national framework for managing water resources;
- The framework for the preparation of catchment management strategies;
- Provision of water-related information; and
- Identification of development opportunities and constraints.

A brief description is given of the need to manage water resources in an integrated way, and in co-operation with all relevant government institutions, the private sector, water users and other interested and affected persons, and of the contribution that integrated water resources management can make to eradicating poverty and addressing gender issues.

Chapter 2 – South Africa's water situation

This chapter provides aggregated estimates of the present availability of and requirements for water in each of the water management areas, indicates how water availability and water requirements may be expected to change in the future, and describes possible strategies and interventions for achieving a balance between water availability and requirements. Some basic concepts relating to water resources management are explained. See also Appendix D - *Additional Information and Strategic Perspectives with respect to Water Management Areas*, which presents a more detailed analysis of South Africa's water situation by providing present

and future water balance information and possible reconciliation interventions for subdivisions of the 19 water management areas.

Chapter 3 – Strategies for water resources management

The strategies, objectives, plans, guidelines and procedures required to implement the provisions of the National Water Act are described in this chapter. Brief explanations of the requirements of the Act are given to put the strategies, etc, into context. Successive parts of the chapter give information about strategies for the protection of water resources, water use, water conservation and water demand management, water pricing, water management institutions, monitoring and information systems for water resources, and disaster management. The last two parts of the chapter present an indicative programme for the major implementation activities, and the broad financial implications of implementation.

Chapter 4 – Complementary strategies

The chapter includes a broad overview of the ways in which water management capacity can be built among practitioners in the South African water sector, describes the Department's approach to creating awareness and understanding of water issues among water users and other stakeholders, and outlines the Water Research Commission's plans for water research.

Chapter 5 – National planning and co-ordination, and international co-operation in water management

The principal relationships between water resources management strategies and other relevant policies and laws are described in this chapter. The necessity for co-operation among all spheres of government to achieve national development goals is emphasised. The final section of the chapter discusses international co-operation in water matters.

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INTRODUCTION TO THE NATIONAL WATER RESOURCE STRATEGY

Ms Buyelwa Sonjica, MP
Minister of Water Affairs and Forestry

Background

As it flows through the landscape water brings a variety of benefits to a range of users. It sustains us and our families; it waters the wide fields of commercial farmers; it nurtures the crops and stock of rural communities; it provides recreation for our children; it supports power generation and our mines and industry; and it nourishes the plants and animals that make up our ecosystems.

Water gives life. The amount and nature of the available water determines the extent and nature of that life and dictates where development can take place. South Africa's water belongs to its people, but it is the task of government to care for this water, to seek its fair distribution and to facilitate its wise use for, among other things, social and economic development and transformation. Such development is crucial to ensure that we can eradicate the scourge of poverty that stalks our land. Under apartheid, development benefited a small white minority while black townships and homelands were under-resourced and underdeveloped – these are the areas where poverty is most intense today.

When the first democratically elected government came to power in our country in 1994 it put forward as its manifesto the Reconstruction and Development Programme. This initiative was based on the fundamental concept that people who are affected by decisions should take part in making them, and it set out five key programmes: meeting basic needs; developing our human resources; democratising the State and society; building the economy; and implementing the Reconstruction and Development Programme. Water is an essential ingredient in each of these programmes.

The Constitution of the Republic of South Africa (1996) contains both our Bill of Rights and the framework for government in South Africa. Two provisions of the Bill of Rights are particularly relevant to the management of water resources. These are sections 27 and 24, which state that-

- Everyone has the right to have access to, among other rights, sufficient food and water, and the State must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of these rights.
- Everyone has the right to an environment that is not harmful to their health or wellbeing, and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation, and secure sustainable development and use of natural resources while promoting justifiable economic and social development.

These two documents – the Reconstruction and Development Programme and the Constitution – provided the impetus for a complete review and revision of the policy and law relating to water, and resulted in the development of the National Water Policy for South Africa (1997) and the National Water Act (1998). The Policy and the Act are founded on the principles of equity, sustainability and efficiency, each of which is important for different reasons.

• **Equity**

South Africa's previous water legislation, the 1956 Water Act, was not in itself racist in the way that the 1913 Land Act was. However, access to water for productive purposes was tied to land. The riparian system enshrined in the former Act gave access to water mainly to those across or alongside whose land it flowed, or under whose land it was found. Since access to land was determined along racial lines under the apartheid system, access to water was thus similarly determined by skin colour.

This has given rise to what is perhaps the most important challenge facing our water managers, which is the need to introduce equity in resource distribution. Too many of our people are poor. The goals of sustainability and efficiency cannot be divorced from this, and neither can the responsibility of all South Africans to share water and to use it well. We are now equipped with the legal mechanisms that allow us to reallocate resources from those who have been favoured by history to those who have been neglected. But at the same time we have to consider the complex linkages that exist between the benefit to society, the state of the environment and the needs of the economy - the lifeblood of the country has to be maintained. Water is one obvious tool for the eradication of poverty, providing a way for the poorest of our people to survive and make a living, a burden that so often rests upon women in society. It is the responsibility of the Department of Water Affairs and Forestry to ensure that South Africans use water resources wisely in the country's search for social justice. At the same time, the competing needs and demands of industry, agriculture, cities and ordinary people all need to be catered for, now and in the future. The National Water Resource Strategy sets us on this path.

South Africa is moving slowly from a patriarchal society to one in which women are encouraged to take their rightful role as equals alongside men. The National Water Act requires the government to address the issues of gender inequity in water as much as it must address inequity arising from race or disability.

- ***Sustainability***

Over the past few decades we have increasingly come to understand the interdependence between humankind and ecosystems, and that our activities often affect the quality and quantity of available water. We have also increasingly recognised our obligation to protect the natural environment, while at the same time promoting development that will meet the needs of not only current generations, but of future generations as well.

- ***Efficiency***

South Africa is a water-scarce country. Our average annual rainfall is a little more than half of the world average, and much of our country is semi-arid. Across most of the country the potential evaporation is higher than the rainfall. Our land is vulnerable to floods and droughts and all of us have shared the horror of floodwaters sweeping away people, houses and roads. We have also shared with our farmers and our rural communities the bitter longing for rains that never seem to come. Our water resources are limited and it is essential that we use them efficiently and in the best interests of all our people.

Integrated water resources management

The three principles of equity, sustainability and efficiency come together in the field of water resources management to achieve integrated water resources management. As enshrined in the National Water Act, integrated water resources management is intended to enable us to meet the needs of our people for water, jobs and economic growth in a manner that also allows us to protect and, where necessary, rehabilitate our aquatic ecosystems. Above all, integrated water resources management will make it possible for us to use our precious water to assist in addressing the overwhelming need to eradicate poverty and remove inequity in South Africa.

The National Water Resource Strategy sets out the ways in which we aim to achieve integrated water resources management in South Africa. It describes the policies, strategies, plans and procedures by which this will be done. It is a remarkable document, the first of its kind in South Africa. It is intended to be a living and interactive document that will continue to grow and change as the needs, capacities and understanding of our people change and grow.

State of the nation's water resources

Our understanding of our water resources is continually expanding. A wide range of institutions and individuals continue to contribute to this core of knowledge. We will be publishing a report on the state of the nation's water resources when the data has been compiled, but in the

meantime non-availability of this information makes it difficult for South Africans to gauge where the country currently stands. We read in the newspapers about pollution problems in our rivers, about dams overflowing, clean-up campaigns, cholera and conservation issues. We hear about potential water shortages, about invasive alien species drying up our water. And perhaps we wonder what the meaning of all this is.

- ***We have enough water***

Firstly, we have enough water to meet our nation's needs for the foreseeable future. But we need to use that water sparingly, and we must reduce and avoid pollution. We need to be conscious of the fact that we live in a water-scarce country. We must remain conscious of the fact that in situations of water scarcity the poor are generally the ones who feel the pinch hardest. Indeed, even in situations where water is abundant, the poor often experience scarcity through the lack of infrastructure to bring the water to where it is needed. We are not on the point of running out of water, but we have to use our limited water supplies more efficiently and effectively.

Water use in South Africa is dominated by irrigation, which accounts for around 62 per cent of all water used in the country. Domestic and urban use accounts for about 27 per cent, while mining, large industries and power generation account for some 8 per cent. Commercial forestry plantations account for a little less than 3 per cent of total use by reducing runoff into rivers and streams.

South Africa's rivers are small in comparison with those in many other countries. The Orange River carries only about 10 per cent of the volume of water flowing down the Zambezi River and about 1 per cent of the flow in the Congo River. The total average annual surface runoff of a little more than 49 000 million cubic metres of all our rivers combined is less than half of the Zambesi's annual flow. Furthermore, many of our larger rivers, such as the Orange/Senqu and the Limpopo, are shared with other countries.

A recent high-level analysis by my Department showed that in the year 2000, 10 of the 19 water management areas in the country were facing a water deficit. In other words, in these catchments people are using so much water that either the ecosystems have been placed under severe stress or other users cannot rely on getting their fair share. We will have to take action to bring water use in these catchments back to within sustainable availability levels, that is, to balance the demand for water with supply. The main tools for doing so include increased water use efficiency, removal of infestations of invasive alien vegetation (which, like afforestation, also reduce runoff), the development of additional infrastructure such as dams and inter-basin transfer systems to store water and bring it from areas of surplus to areas experiencing shortages, promotion of water trading and the reallocation of water use by compulsory licensing. We will also have to deal with localised areas of water stress in otherwise well-resourced water management areas.

If we look forward to the year 2025, even if we factor in further infrastructure development, we find that several additional water management areas will most likely be in a situation of water deficit. Infrastructure development is an expensive option, and for this reason improvements in the efficient use of currently available water resources must be given priority.

Development needs to be encouraged in those catchments where there is still water available for use. In order to facilitate such development, the Department has published general authorisations that enable water use to take place, under specified conditions, without a licence having to be issued.

- ***Water quality***

Just as planning and management take place to supplement water in areas of scarcity, they are also applied to the improvement of water quality. For example, irrigation water in the fertile valleys of the Eastern Cape used to be too little and too saline to make the most of the area's

agricultural potential. To address this shortcoming, the Department has, since 1976, been transferring water from the Orange River to the Eastern Cape via the Orange-Fish Tunnel. The increased availability of good-quality water and the resultant reduction in salinity has proved to be of tremendous benefit to economic growth and job creation in the area.

In other parts of the country water quality poses considerable problems and cannot be resolved so easily. For instance, although only 2 per cent of water reaching the Vaal Dam comes from the Waterval catchment of the Highveld, an area of intensive mining, industry, power generation and other uses, that small percentage is responsible for 12 per cent of the pollution in the dam. The Vaal Dam provides water for domestic purposes for around 10 million people and, because of the pollution, treatment costs are high.

In a similar manner, on a daily basis across the country, organisations and individuals impact on the water quality in our rivers and streams, our groundwater and our wetlands.

Salinity

Mining and irrigation affect the salinity (the amount of dissolved salts in the water) of our water resources and reduce the quality of water. The Vaal and Harts rivers are affected by agricultural irrigation, but high salinity may also be the natural result of catchment geology, such as in the Fish River in the Eastern Cape, which flows through the saliferous Karoo region, or the Breede River in the Western Cape.

Eutrophication

Water quality is also affected by eutrophication, the enrichment of the water, particularly in dams but also in rivers, by nutrients such as phosphates and nitrates. A high nutrient concentration in combination with light and warm temperatures promotes the growth of algae. One species, the cyanobacteria or blue-green algae, which causes a toxic scum, poses a particular problem. Algae increase the cost of water purification and are a physical threat to treatment plants as they clog filters and pumps, while reducing the carrying capacity of pipelines and canals. The main sources of nutrients are fertilisers used in the agricultural sector and poorly maintained sanitation systems. It can take decades to reverse eutrophication in a dam, since phosphates settle into the sediment and are released back into the water when conditions are right, resulting in renewed algal bloom. The Middle Vaal River and the Hartbeespoort, Inanda, Laing and Bridlesdrift dams are all affected by eutrophication.

Bacteriological contamination

Bacteriological contamination, which arises not only from the absence of or the poor maintenance of sanitation facilities, but also from livestock defecation entering rivers and streams, is widespread in the country. The consumption of untreated water is one of the main sources of disease in South Africa.

Other contamination

Localised pollution also takes place in urbanised and industrialised areas. Pollutants may range from conservative inorganic materials (typically, salts which remain in the water because they are not broken down by natural biological processes) to metal and/or organic compounds (such as pesticides) some of which may be biodegradable.

The challenge that faces us as a country is to promote socio-economic development while maintaining a water quality that is at all times still fit for use, and for the proper ecological functioning of aquatic ecosystems. Another challenge lies in the protection of our aquatic ecosystems.

- ***The ecological state of rivers in South Africa***

The River Health Programme, through its State of Rivers initiative, collects stores and interprets river health data in a systematic and quality-controlled manner. The interpretation of river health information permits different river health categories, such as natural, good, fair or poor, to be

allocated to each section of the river. This system enables the comparison of the health of one river or section of a river with that of another.

If a river is described as “natural” it means that it is relatively unaffected by human activities, and its in-stream and riparian habitats and associated biota show minimal modification. Such natural systems are important for the conservation of biodiversity and for providing a benchmark of what “natural” really looks like. A river in a poor state is usually characterised by high human impacts or direct exploitation. This often results in a decline in habitat diversity with only the most tolerant species still present. Often such species have diseases and their population dynamics have been disrupted - that is, they can no longer breed - or alien species have invaded the ecosystem. Poor river health is regarded as unacceptable from a resource management perspective and requires management intervention to restore flow patterns, river habitats and water quality.

Very few rivers in South Africa qualify as truly natural systems, and many of them are located in protected areas such as national or provincial parks and wilderness areas. However, even the lower reaches of a river that flows through a protected area may be impacted by upstream developments that fall outside the protected area, as is the case for most of the rivers flowing through the Kruger National Park.

By August 2002 six river systems, which represent a reasonable sample of typical South African rivers, had been surveyed in four provinces under the River Health Programme. If the results of these surveys are extrapolated to indicate the overall health of rivers in South Africa, the generalised picture is as follows: 11 per cent of rivers are in a natural state; 26 per cent are in a good state; 32 per cent are in a fair state; and 31 per cent are in a poor state. The distribution of health categories between rivers varies considerably. For example, approximately 50 per cent of the Sabie-Sand river system (Mpumalanga and Limpopo Provinces) is in a natural to good state, whereas only 13 per cent of the Modder River (Free State Province) remains in a natural to good state.

Experience to date has highlighted the following factors as being the most common threats to the health of our rivers -

- *Over-utilisation of riparian zones.* This impairs the ability of riparian buffer zones to filter nutrients and sediment before they enter a river, to provide habitat and migration options for many species, to stabilise river banks and to act as a flood control mechanism.
- *Alien species of fauna and flora.* This includes aquatic species such as trout and terrestrial species such as wattle trees.
- *Regulation of flows and water abstraction.* Dam walls and weirs act as barriers to the natural movement of fish and other aquatic species. Regulated flows that do not mirror natural seasonal variations have an impact on the resilience of river systems. Reduced water levels reduce diversity and the availability of aquatic habitats.

International rivers

Rivers do not respect political boundaries. Many cross national boundaries (trans-boundary rivers) and some form the boundary between countries (contiguous rivers). South Africa shares four major river systems with neighbouring countries:-

- The Orange/Senqu system is shared with Lesotho (trans-boundary) and Namibia (contiguous).
- The Limpopo River is shared with Botswana and Zimbabwe (contiguous) and Mozambique (trans-boundary).
- The Incomati system is shared with Swaziland and Mozambique (trans-boundary)
- The Usutu/Pongola-Maputo system is shared with Mozambique and Swaziland (trans-boundary).

The Revised Protocol on Shared Watercourses in the Southern African Development Community provides the framework for the management of these rivers, whilst the National Water Act gives international requirements a priority that is second only to basic human needs and the ecological Reserve.

Conclusion

The Department of Water Affairs and Forestry is the custodian of the nation's water resources. The challenge before us is to manage these resources in a manner that promotes equity, sustainability and efficiency. In particular, we must harness our water resources in the battle against the inequality, poverty and deprivation that continue to plague our nation. The National Water Resource Strategy sets out our plans to achieve this. It is an ambitious document dealing with an ambitious project. But South Africans have proved time and time again that they can rise to the biggest challenges. This is a challenge that all South Africans must rise to, together.

CHAPTER 1 - WATER POLICY, WATER LAW AND WATER RESOURCES MANAGEMENT

1.1 THE NATIONAL WATER POLICY

Government policy since 1994 has focused strongly on equitable and sustainable social and economic development for the benefit of all South Africa's people. However, many existing laws, including the law relating to water, were not at all appropriate to achieving these objectives. The National Water Policy for South Africa (NWP), adopted by Cabinet in 1997, was introduced in response to the new direction set by government and as part of a thorough review of existing water law.

The NWP was preceded by the development of 28 Fundamental Principles and Objectives for a New South African Water Law, which are reproduced in full in Appendix A. Principle 7 is particularly relevant: it states that –

The objective of managing the quantity, quality and reliability of the Nation's water resources is to achieve optimum, long-term, environmentally sustainable^[1] social and economic benefit for society from their use.

Three fundamental objectives for managing South Africa's water resources, which are firmly grounded in the provisions of the Bill of Rights of the Constitution of South Africa, 1996 (No. 108 of 1996) arise from the Principles. These are the following -

- **To achieve equitable access to water**, that is, equity of access to water services, to the use of water resources, and to the benefits from the use of water resources.
- **To achieve sustainable use of water** by making progressive adjustments to water use with the objective of striking a balance between water availability and legitimate water requirements, and by implementing measures to protect water resources.
- **To achieve efficient and effective water use** for optimum social and economic benefit.

Important proposals to facilitate achievement of the NWP's objectives include the following:-

- Water will be regarded as an indivisible national asset. National government will act as the custodian of the nation's water resources and its powers in this regard will be exercised as a public trust.
- Water required to meet basic human needs and to maintain environmental sustainability will be guaranteed as a right, whilst water use for all other purposes will be subject to a system of administrative authorisations.
- The responsibility and authority for water resource management will be progressively decentralised by the establishment of suitable regional and local institutions. These will have appropriate community, racial and gender representation to enable all interested persons to participate.

Implementation of the Policy proposals will fundamentally change the ways in which South Africa's water resources are managed.

1.2 THE NATIONAL WATER ACT

(The purpose of the National Water Act, which embodies the NWP's objectives for water resources management, is given in section 2 of the Act – see Appendix B)

The National Water Act, 1998 (No. 36 of 1998 - the Act) derives directly from the Fundamental Principles and Objectives for a New South African Water Law and the NWP's proposals for managing water resources^[2]. The Act is the principal legal instrument relating to water resources management in South Africa and contains comprehensive provisions for the protection, use^[3],

development, conservation, management and control^[4] of South Africa's water resources. It is these legal provisions that enable the proposals in the NWP to be implemented^[5].

The Act is not, however, the only instrument through which the objectives of the NWP will be achieved. Since water is essential for all life and human endeavours, there are many other policies and laws, administered by a number of departments in all spheres of government, which govern activities dependent on water, or affect water resources. The 1994 Water Supply and Sanitation Policy White Paper (now superseded by the Strategic Framework for Water Services, 2003)^[6], and the Water Services Act, 1997 (No. 108 of 1997), which deal with the provision of potable water and sanitation services, are particularly closely related to the Act.

In addition, the management of water as a renewable natural resource must be carried out in a manner consistent with the broad environmental policy of government and within the framework of environmental legislation, that is, the National Environmental Management Act, 1998 (No. 107 of 1998), and those parts of the Environment Conservation Act, 1989 (No. 73 of 1989), that have not yet been repealed by the more recent legislation.

Successful water resources management will therefore depend on co-operation among all spheres of government, and the active involvement of water users and other organisations and stakeholders. The necessity for an integrated approach to water resources management is discussed later in this chapter, while the relationships between water policy and law, and other relevant policies and laws, are discussed in Chapter 5.

Many of the Act's provisions are described briefly in this document in order to provide the context for subsequent explanations of their practical application. An important provision, which is key to the achievement of Policy objectives, is the establishment by the Act of national government, acting through the Minister of Water Affairs and Forestry (the Minister), as the public trustee of the nation's water resources. (Public trusteeship is described in section 3 of the Act - see Appendix B). This provision resolves a significant difficulty of the Water Act, 1956 (No. 54 of 1956)^[7], which was based largely on the riparian system of water rights^[8] and resulted in no single organisation or institution being able to exercise complete authority over water in South Africa. Public trusteeship does not mean that government owns the water, since the Preamble to the Act recognises that "water is a natural resource that belongs to all people", but it does mean that the Minister has overall responsibility and, importantly, the authority to ensure that all water everywhere in the country is managed for the benefit of all persons. This responsibility includes ensuring that water is allocated equitably, and that environmental values are promoted.

1.3 THE NATIONAL WATER RESOURCE STRATEGY

(The Act requires the National Water Resource Strategy to "... set out the strategies, objectives, plans guidelines and procedures of the Minister and institutional arrangements relating to the protection, use, development, conservation, management and control of water resources ...". The Act's requirements are described in sections 5, 6 & 7, which are reproduced in full in Appendix C).

The Act requires the Minister^[9] to establish a National Water Resource Strategy (NWRS) as soon as reasonably practicable by publishing a Notice in the *Government Gazette*.

The NWRS must provide information about the ways in which water resources will be managed and the institutions to be established. It must also provide quantitative information about the present and future availability of and requirements for water in each of 19 water management areas (see Chapter 2, Fig. 2.2, Part 5 of Chapter 3, and Appendix E), and propose interventions by which these may be reconciled. The NWRS must also quantify the proportion of available water in each water management area that falls under the direct control of the Minister in terms of her or his national responsibilities^[10].

1.3.1 The purposes of the National Water Resource Strategy

The national framework for managing water resources

After its establishment the NWRS will provide the framework within which water resources will be managed throughout the country, because section 5(3) of the Act states that South Africa's water resources must be protected, used, developed, conserved, managed and controlled in accordance with the NWRS.

The NWRS will be legally binding since section 7 specifies that the Minister, the Director-General, other organs of State and water management institutions must give effect to its provisions when exercising any power or performing any duty in terms of the Act.

Although the NWRS is intended to be an enduring framework for water resources management, it may be amended to suit changing circumstances during the reviews specified in section 5(4)(b). However, such amendments may only be made after mandatory consultations with stakeholders. Reviews must take place at least every five years.

The framework for the preparation of catchment management strategies

A catchment management strategy is the framework for water resources management in a water management area. The NWRS provides the framework within which all catchment management strategies will be prepared and implemented in a manner that is consistent throughout the country. In particular, in terms of section 9(b), a catchment management strategy must not be in conflict with the NWRS. It is anticipated that insights and information gathered during the development of catchment management strategies will inform the regular review of the NWRS, enabling it to remain relevant to local conditions and circumstances.

In this regard an important component of the NWRS is the data and information provided in Chapter 2 and Appendix D, which quantify water availability and water requirements in each water management area. Consideration of this information in conjunction with the Minister's national responsibilities enables the amount of water for which each catchment management agency will be responsible to be determined.

Provision of information

In accordance with the general requirement for transparent and accountable public administration in all spheres of government, the Act requires the Minister to ensure that all aspects of water resource management that will affect other organs of State, water users and the public in general are brought to their attention. The NWRS is the vehicle by which South African society is informed of the Minister's intentions concerning water resource management. Every subsequent edition of the NWRS must also be made publicly available.

In addition, each edition of the NWRS may be formally established only when the Minister is satisfied that everyone who wishes to comment on the Proposed Strategy has been afforded an opportunity to do so, that all comments have been given careful consideration and that all changes arising from this process have been incorporated in the revised Strategy.

Identification of development opportunities and constraints

The water availability information presented in the NWRS - for each water management area in Chapter 2, and for subdivisions of each area in Appendix D - makes it possible to identify the areas of the country in which water resources are available to support social and economic development initiatives, as well as areas in which limited water resources may be a constraint to development.

Appendix D provides a broad strategic perspective for each water management area in which, among other things, indications are given of possible developments for which available water might be used. These are however by no means definitive, and the possible opportunities and

constraints will be investigated in more detail in the process of developing and refining the catchment management strategies.

It must also be emphasised that the purpose of the NWRS is to strategically direct the management of water resources from a national perspective, and the water availability information is therefore relatively coarse. The information is not appropriate, nor is not intended to be used, for planning individual projects. These must be investigated using more detailed information, as well as being the subject of the impact assessments required by environmental legislation.

1.4 INTEGRATED WATER RESOURCES MANAGEMENT

(The need for an integrated approach to water resources management is discussed in the National Water Policy. It is also explicitly acknowledged in the Preamble to the Act, which recognises that water occurs in many different forms which are all part of a unitary, inter-dependent cycle. The Preamble also recognises the need for the integrated management of all aspects of water resources).

There is increasing understanding internationally that water resources can be successfully managed only if the natural, social, economic and political environments in which water occurs and is used are taken fully into consideration.

Integrated water resources management (IWRM) may be defined as a process which promotes the co-ordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. IWRM therefore aims to strike a balance between the use of resources for livelihoods and conservation of the resource to sustain its functions for future generations, and promotes social equity, environmental sustainability and economic efficiency. Because the resource cannot be considered separately from the people who use and manage it, a balanced mix of technological and social approaches must be used to achieve integrated management.

The dimensions of integrated water resources management

Freshwater is a complex ecological system that has a number of dimensions. Surface water, groundwater, quantity and quality are all linked in a continuous cycle - the hydrological cycle - of rainfall, runoff from the land and infiltration into the ground, and evaporation from the surface back into the atmosphere. Each component may influence the other components and each must therefore be managed with regard to its inter-relationships with the others.

Water as a system also interacts with other systems. Human activities such as land use, waste disposal and air pollution can have major impacts on the quantity and quality of water available for human use, while the abstraction and storage of water and the discharge of waste into water resources can impact on the quality of the natural environment. These interactions must be considered and addressed by water resource managers.

Taking an even broader view, water must also be managed in the full understanding of its importance for social and economic development.

It must also be borne in mind that South Africa shares four major river basins, which together cover about 60 per cent of South Africa's land area and account for around 40 per cent of the total surface runoff, with neighbouring countries. The NWP accords high priority to harmonious relations over water with neighbouring states, and the NWA provides for water to be made available to meet international rights and obligations. The international dimensions of IWRM are therefore critically important for South Africa. The framework within which international water-related issues are addressed is discussed in more detail in Chapter 5.

Co-operative planning and management of water resources

The complexity of managing water as a system and its interactions with other systems is further compounded by the large number of institutions and organisations - both domestic and international - involved in the administration and management of the various systems.

The Department of Water Affairs and Forestry (the Department) is currently responsible for water resources management at national level. The Act requires the Department to ensure that its programmes are in accordance with government policy and are co-ordinated with relevant programmes of other national departments (see Chapter 5). Similarly, other departments have a responsibility to ensure that, where relevant, their programmes take account of the realities of South Africa's water situation. This is particularly important when it comes to planning developments that depend on water for their success. In these instances the availability of water must be factored into plans at the beginning of the development process. One of the purposes of the NWRS is therefore to provide sufficient information about water resources to facilitate coherent and holistic planning, as well as establishing a platform for informed interactions between water resource managers and development planners in other sectors.

In terms of the Act and the NWRS the Department is in the process of establishing 19 catchment management agencies, each operating in a defined water management area, to manage water resources at a regional level. These agencies will be responsible, among other things, for ensuring that there is consonance between their water-related plans and programmes and the plans and programmes of all other role players in the catchments they manage. The agencies will therefore have to establish co-operative relationships with a range of stakeholders, including other water management institutions, water services institutions, provincial and local government authorities, communities, water users ranging from large industries to individual irrigators, and other interested parties.

The success of integrated water resources management will therefore depend heavily on the development of a framework of co-operation among all relevant institutions, organisations and individuals. This co-operative framework must facilitate planning at all geographic scales ranging from international projects to activities on individual smallholdings, and the co-ordination of programmes.

Integrated water resources management, poverty and gender

The need for an integrated approach to managing water resources has been articulated at a number of international meetings during the last three decades, each of which has stressed the importance of water for human survival, health and productivity. The two most recent global forums - the United Nations Millennium Summit, September 2000 and the World Summit on Sustainable Development, August 2002 - reaffirmed that people must be at the centre of the sustainable development and use of water resources. Resolutions, agreements and targets arising from these events emphasised, among other things, the importance of water in addressing poverty issues, and the importance of factoring gender considerations into all aspects of water management. In an African context these sentiments are echoed in the policy objectives of the New African Partnership for Development and the Southern African Vision for Water, Life and the Environment in the 21st Century^[11].

IWRM does not provide a complete solution to all the dimensions of poverty, but no strategy for poverty eradication will be successful unless it includes strategies for managing water. The provision of basic water and sanitation services is an essential element of water's contribution to poverty eradication, because it addresses issues of health and hygiene, and the effort required in collecting and carrying water from remote, often polluted water sources. Providing free basic services goes some way to making water affordable to the poor. Basic water services do not however make adequate provision for productive livelihoods

The rural poor, many of whom do not yet have access to reliable water supplies or sanitation services, often rely for their livelihoods on cultivating food, gathering natural products and other

water-dependent activities. But their water sources are often unreliable and insufficient, threatened by droughts and floods, and eroded or degraded by developments over which they have no control.

In South Africa water is regarded as a social, environmental and economic good. Nevertheless, after basic human needs and the requirements for maintenance of ecosystems have been satisfied, there will inevitably be competition for access to the remaining available water. It is essential that water-related policies are implemented in ways that give special attention to ensuring that the poor can meet their needs, and that they are given a voice in decisions that affect them.

In order to successfully address issues of equity IWRM must also consider gender - that is, the implications for men and women of legislation, policies, and implementation strategies and programmes, and the measures required to enable them to participate in water resources management on an equal footing. It has also been shown by international and local experience that poverty eradication initiatives are greatly enhanced by the involvement of women in all aspects of water resources management at all levels.

Women and men bring different perspectives and viewpoints to water management, and play different roles. There are however often considerable imbalances between women and men, in for instance their levels of education and the influence they are able to exercise, and these imbalances must be addressed in initiatives to capacitate the two groups to participate in decision-making. Poor black women are one of the most marginalised groups in South African society. Conscious efforts must therefore be made to involve them in water resources management processes and to ensure that the management of water contributes to meeting their needs.

Careful analysis will be required of water-related developments, whether they involve the construction of infrastructure or relate to demand-side management, to take into account the benefits and costs that accrue to women and men, and to ensure that one group does not benefit at the expense of the other. Special emphasis must be placed on the involvement of women in water resources management institutions and in policy development.

It is not possible to separate issues of poverty, race and gender, but it is necessary to understand how they interact with and impact each other. An integrated approach to managing water resources will contribute to building a society free from poverty and discrimination.

Notes to Chapter 1

¹ In this context "environment" means: The surroundings within which humans exist, and that are made up of (i) the land, water and atmosphere of the earth, (ii) micro-organisms, plant and animal life, (iii) any part or combination of (i) and (ii) and the inter-relationships among and between them and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being. (National Environmental Management Act, 1998, Definitions, section 1(xi)).

² "Water resource" means surface water found in watercourses (rivers and streams), impoundments (dams), wetlands and estuaries, and groundwater found in underground aquifers (see section 1(1)(xxvii)).

³ The Act's definition of water use (section 21) is broad. It relates to the quantitative use of water, as well as to uses that affect water quality and the quality of the resource itself. Accordingly, water use includes abstraction and storage, all aspects of the discharge of wastes into water resources, making changes to the physical structure of rivers and streams, and use for recreational purposes. Water use also includes certain land-based and instream activities that may affect the quantity or quality of water in the resource (stream flow reduction activities, and controlled activities such as hydro-electric power generation and disposal of waste onto land). Water use is described in more detail in Part 2 of Chapter 3.

⁴ Throughout the NWRS "managed" is used as shorthand for the Act's "protected, used, developed, conserved, managed and controlled".

- ⁵ In the remainder of this document the expressions "implementing the Act", "implementing the Act's provisions" and similar are used as shorthand for "implementing the National Water Policy through the provisions of the National Water Act".
- ⁶ The 1994 Water Supply and Sanitation Policy, which focused largely on the Department's direct role in the delivery of basic services for households, has been reviewed to account for the completion of the local government transformation process and the establishment of the local government legislative framework. Local Government can now assume full operational responsibility for its constitutional mandate for water and sanitation services, and the Department's role must change from direct service provision to that of the sector leader, regulator and supporter. The Strategic Framework for Water Services was approved by Cabinet in September 2003. It sets out a comprehensive approach to the provision of water services to eliminate the backlog in basic water services and progressively improve levels of service over time in line with the original aims of the Reconstruction and Development Programme. It also focuses on developing the institutional framework best suited to support Local Government in its responsibilities. The White Paper on Basic Household Sanitation (2001) will also be amended to ensure that it is compatible with the Strategic Framework
- ⁷ The National Water Act, 1998 (No. 36 of 1998) repeals the Water Act, 1956 (No. 54 of 1956).
- ⁸ Riparian system: Those who owned land next to rivers and streams had exclusive and in-perpetuity rights to the use of (but not ownership of) a portion of the water which flowed in them. Those who owned land under which groundwater occurred also effectively had exclusive use of the water. This was "private" water, over which the State had little or no control.
- ⁹ The Act imposes many duties and responsibilities on the Minister, but for practical reasons allows her or him to delegate most of them to others. See also Part 5 of Chapter 3.
- ¹⁰ The Minister's national responsibilities include the Reserve, water to meet international obligations, a "contingency" to meet projected future water needs (which may, for instance, require transfers of water between water management areas) and water use of strategic importance.
- ¹¹ Summary of water-related outcomes from international forums:-

Millennium Development Goals

By 2015, using 1990 as a benchmark:-

- Halve the proportion of people living in extreme poverty and hunger
- Halve the proportion of people without access to safe drinking water (with sanitation added at the World Summit on Sustainable Development, 2002)
- Achieve universal primary education
- Empower women and promote equity between women and men
- Reduce under-five mortality by two-thirds
- Reduce maternal mortality by three-quarters
- Reverse the spread of killer diseases, especially HIV/AIDS and malaria
- Ensure environmental sustainability
- Develop a global partnership for development, with targets for aid, trade and debt relief

World Summit on Sustainable Development Plan of implementation

The Johannesburg Plan of implementation (JPol) affirmed the Millennium Development Goals for water, and also agrees to develop integrated water resources management and water efficiency plans by 2005, through actions to, among other things -

- Develop and implement national/regional strategies, plans and programmes with regard to integrated river basin, watershed and groundwater management, and introduce measures to improve the efficiency of water infrastructure to reduce losses and increase recycling of water
- Employ the full range of policy instruments
- Improve the efficient use of water resources and promote their allocation among competing uses in a way that gives priority to the satisfaction of basic human needs and balances the requirement of preserving or restoring ecosystems and their functions
- Develop programmes for mitigating the effects of extreme water-related events
- Support the diffusion of technology and capacity-building for non-conventional water resources and conservation technologies
- Facilitate the establishment of public-private partnerships

NEPAD Water and Sanitation Sector Policy Objectives:

- Ensure sustainable access to safe and adequate clean water supply and sanitation, especially for the poor
- Plan and manage water resources to become a basis for national and regional co-operation and development
- Systematically address and sustain ecosystems, biodiversity and wildlife

- Co-operate on shared rivers among member states
- Effectively address the threat of climate change
- Ensure enhanced irrigation and rain-fed agriculture to improve agricultural production and food security

Southern African Vision for Water, Life and the Environment in the 21st Century:

A southern Africa where there is equitable and sustainable planning, use, development and management of water resources for poverty alleviation, local and national socio-economic development, regional co-operation and integration, and the environment.

CHAPTER 2 - SOUTH AFRICA'S WATER SITUATION AND STRATEGIES TO BALANCE SUPPLY AND DEMAND

2.1 INTRODUCTION

South Africa is located in a predominantly semi-arid part of the world. The climate varies from desert and semi-desert in the west to sub-humid along the eastern coastal area, with an average rainfall for the country of about 450 mm per year (mm/a), well below the world average of about 860 mm/a, while evaporation is comparatively high. As a result, South Africa's water resources are, in global terms, scarce and extremely limited. The country has no truly large or navigable rivers, and the combined flow of all the rivers in the country amounts to approximately 49 000 million cubic metres per year (m³/a), less than half of that of the Zambezi River, the closest large river to South Africa. Groundwater plays a pivotal role in especially rural water supplies. Because of the predominantly hard rock nature of the South African geology, only about 20 per cent of groundwater occurs in major aquifer systems that could be utilised on a large scale.

Due to the poor spatial distribution of rainfall, as shown in Fig. 2.1, the natural availability of water across the country is also highly uneven. This situation is compounded by the strong seasonality of rainfall, as well as high within-season variability, over virtually the entire country. Consequently surface runoff is also highly variable. As a result, stream flow in South African rivers is at relatively low levels for most of the time. The sporadic high flows that do occur limit the proportion of stream flow that can be relied upon to be available for use. These circumstances also have implications for water-related disasters such as floods and droughts (see Part 7 of Chapter 3). To aggravate the situation, most urban and industrial development, as well as some dense rural settlements, have been established in locations remote from large watercourses, dictated either by the occurrence of mineral riches or influenced by the political dispensation of the past. As a result, in several river basins the requirement for water already far exceeds its natural availability, and widely-spread and often large-scale transfers of water across catchments have, therefore, already been implemented in past decades.

Four of South Africa's main rivers are shared with other countries. These are the Limpopo, Inkomati, Pongola (Maputo) and Orange (Senqu) Rivers, which together drain about 60 per cent of the country's land area and contribute about 40 per cent of its total surface runoff (river flow). Approximately 70 per cent of its gross domestic product (GDP) and a similar percentage of the population are supported by water supplied from these rivers, making their judicious joint management of paramount importance to South Africa.

To facilitate the management of water resources, the country has been divided into 19 catchment-based water management areas, which are described in more detail in Part 5 of Chapter 3.

The imbalances between the occurrence of and requirements for water are profoundly evident when comparing some basic parameters presented in this chapter for the different water management areas. Of the 19 water management areas only the Mzimvubu to Keiskamma management area is currently not linked to another management area through inter-catchment transfers. The inter-linking of catchments gives effect to one of the main principles of the National Water Act (the Act), which designates water as a national resource. Eleven of the 19 water management areas share international rivers.

The location and boundaries of the different water management areas, as well as inter-water management area transfers, are shown in Fig. 2.2. Key statistics for each water management area, as well as a concise description of strategic action plans in compliance with section 6(1) of the Act, follow. More detail in this regard can be found in Appendix D, where the relationship

Figure 2.1: Rainfall and evaporation

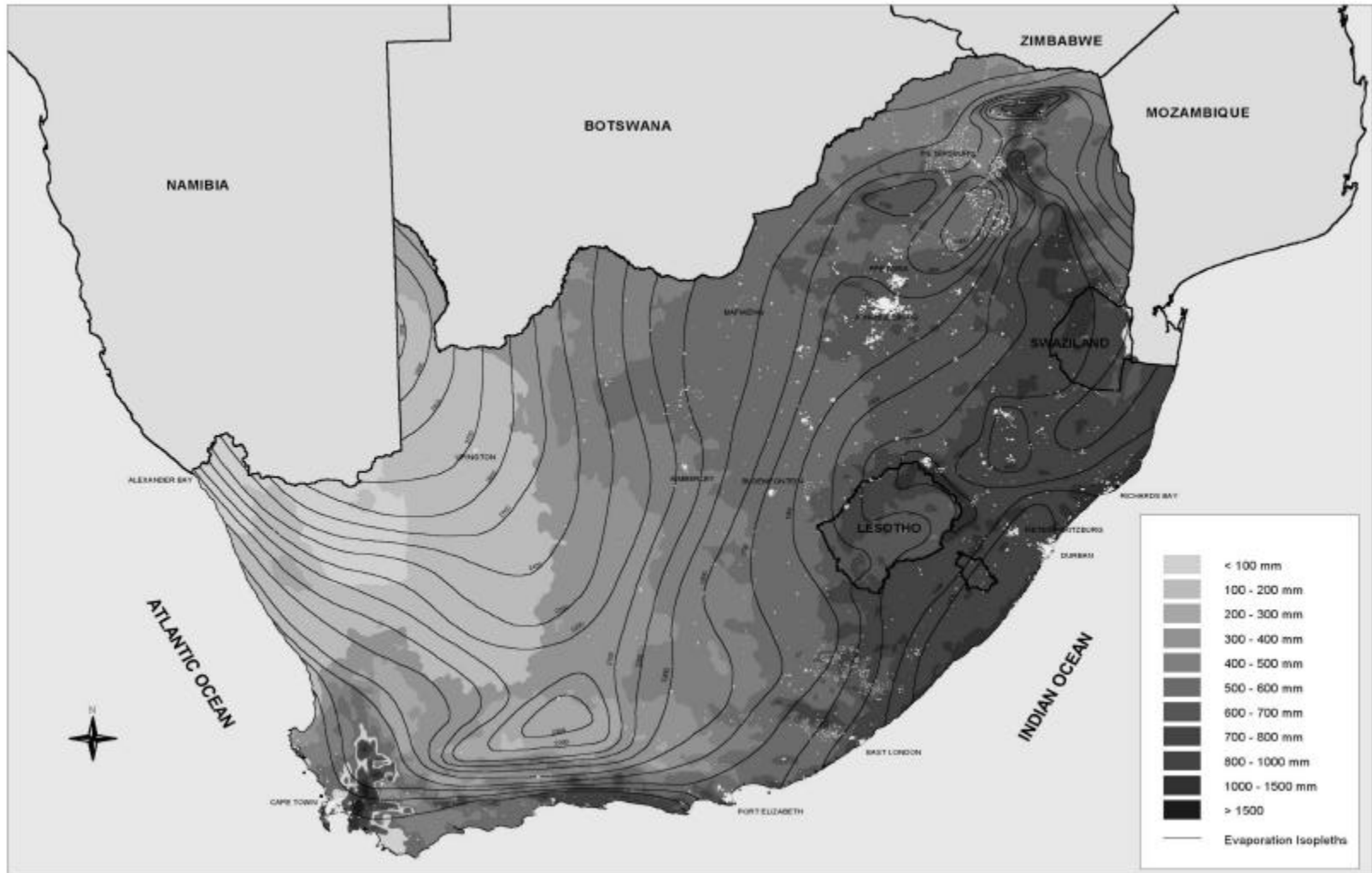
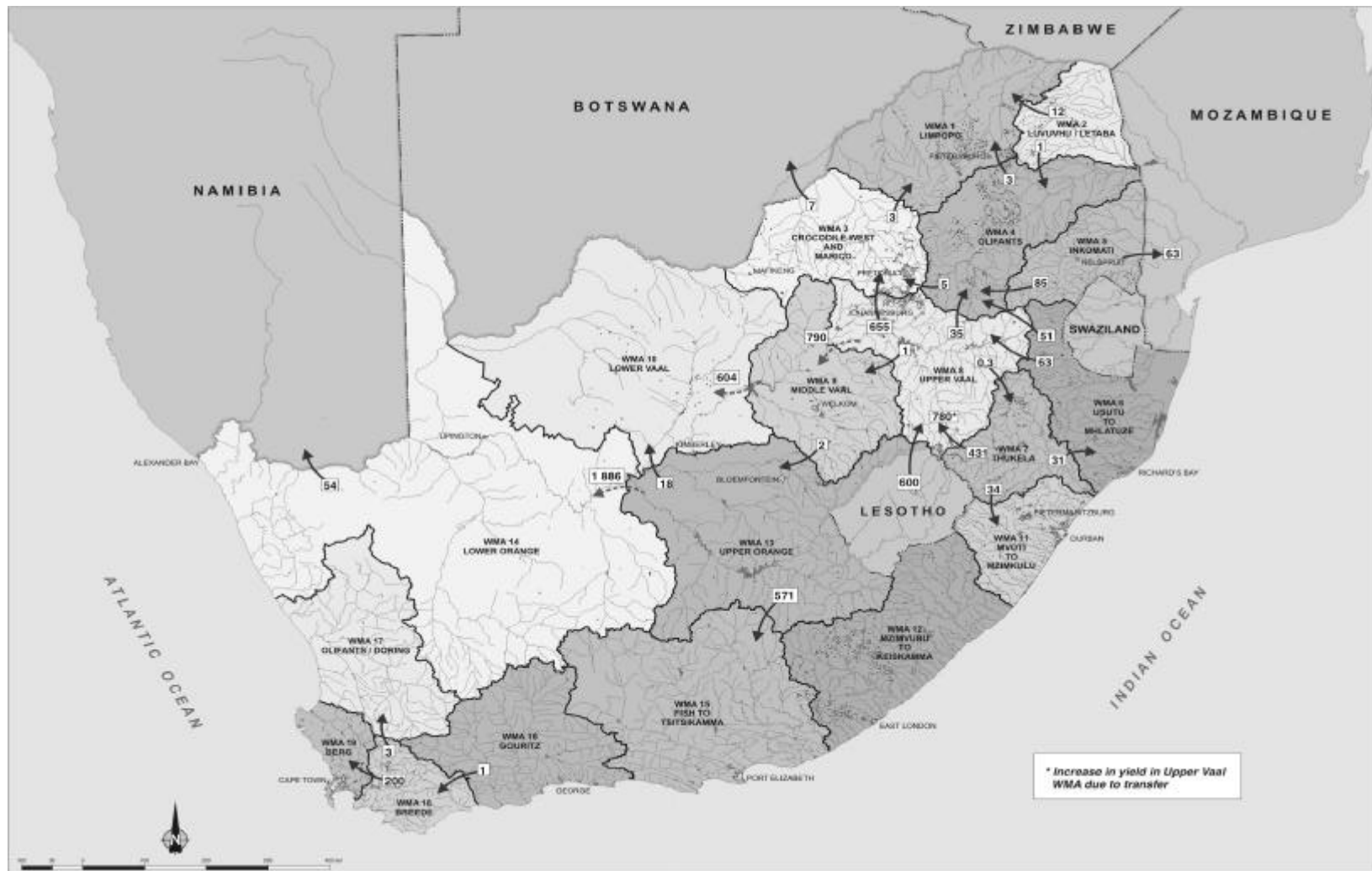


Figure 2.2: Location of water management areas and inter-water management area transfers



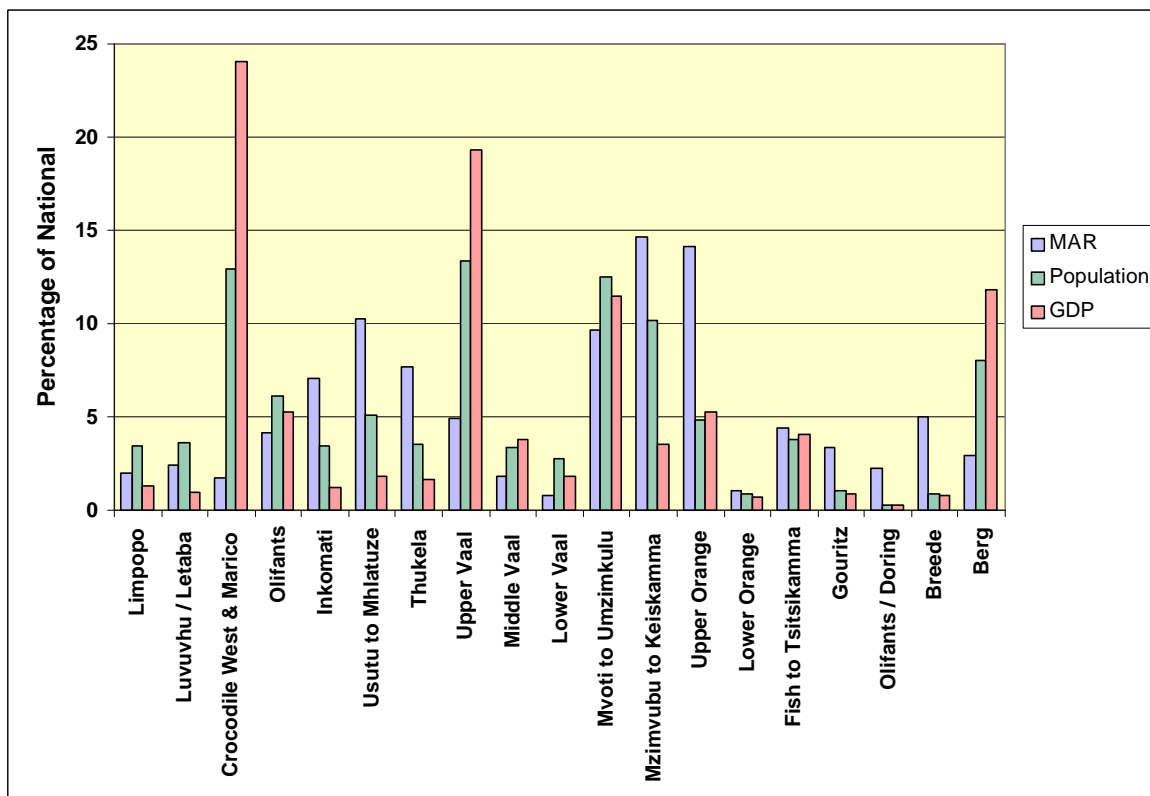
between the National Water Resource Strategy (NWRS) and catchment management strategies is also described.

Every care had been taken to compile and present the best available data and statistics on the availability of and requirements for water in each water management area, to disaggregate the data to subdivisions of each area, and to provide estimates of the water requirements of user sectors^[1]. It is however important to note that the information given in the NWRS is intended to identify areas where there are imbalances in availability and requirements, and to serve as background for the formulation of more detailed, nationally-consistent strategies to reconcile the two in each water management area. The data is not sufficiently accurate to consider the water balance in smaller geographic areas, nor to address the water requirements of individual user sectors in these areas. Work at a substantially greater level of detail, to be carried out by or on behalf of the catchment management agencies, will be required as the basis for the formulation of strategies for each water management area, and to facilitate the actual allocation of resources among users and user sectors. Similarly, it should be noted that the strategic perspectives given in this chapter are of a broad national nature, whilst those in Appendix D relate to the requirements of the 19 water management areas, as well as providing an indication of the requirements of adjacent or linked catchments. The information given in Appendix D serves as a basis for further, more detailed work during the development of the catchment management strategies.

In particular, the water management area availability data does not represent the quantities of water that may be allocated by the catchment management agencies, referred to in section 23 of the Act^[2]. These determinations are necessary before general, compulsory licensing of water use can be undertaken (see Part 2 of Chapter 3). They require, among other things, the Reserve to be determined for all significant water resources in the water management area, and they will form part of the development of the catchment management strategies.

A graphical comparison of the natural occurrence of water, the population and the economic activity per water management area is given in Fig. 2.3, which clearly demonstrates the exceedingly varied conditions among the water management areas. The Crocodile West and Marico water management area for example, where the largest proportional contribution to GDP is produced, is one of the management areas with the smallest mean annual runoff. In contrast, economic activity in the Mzimvubu to Keiskamma water management area is relatively low, despite it being the water management area with the highest mean annual runoff in the country.

Fig. 2.3: Comparison of the mean annual runoff (MAR), population and economic activity (GDP) per water management area



2.2 A BROAD PERSPECTIVE ON THE WATER SITUATION

Water resource development and management in South Africa have continuously evolved over the years to meet the needs of a growing population and a vibrant economy. Considering the constraints imposed by nature these developments have largely been made possible by recognising water as a national asset, which permits its transfer from where it is available to where the greatest overall benefits for the nation can be achieved. South Africa is today recognised internationally for its progressive water legislation and its sophistication in water resources management.

Sufficient water resources have been developed to ensure that all current requirements for water can reasonably be met without impairing the socio-economic development of the country. Specific cases where problems may be experienced are covered in the remainder of this chapter and in Appendix D.

An inheritance from the previous water act, which in many instances linked access to water resources to land ownership, is the current inequity in water use among the country's population groups. Situations also occur where people do not have access to a reliable source of potable water. This is largely due to a lack of infrastructure and funding for its provision and operation, since sufficient water resources are normally available, especially groundwater resources in rural areas. Putting both of these situations right is of exceptional priority for the Department of Water Affairs and Forestry (the Department), and they are being addressed by the Department in close co-operation with other relevant government departments and institutions (see Chapter 5).

To meet the country's growing water requirements, water resources are highly developed and utilised in large parts of the country. As a result of the many control structures (dams and weirs), the abstraction of water and return flows to rivers, as well as the impacts of land use, the flow

regime in many rivers has been significantly altered. In some instances this has resulted in a severe degradation of the quality of water and the integrity of aquatic life in rivers. The anticipated further industrialisation of the economy and urbanisation of the population will result in further deterioration of the country's rivers unless appropriate and timely corrective measures are taken. There are indications that, during the last three decades, the use of groundwater for intensive irrigation schemes has substantially increased in some areas (see Note 3 to Table 2.2 below). This, and to a lesser extent dewatering of mines, has led to localised depletion of groundwater resources and in some cases deterioration of water quality. Much of the focus of the National Water Resource Strategy (NWRS) is therefore on the sustainable use of the country's water resources. A principal objective of the NWRS is to ensure an adequate supply of water to underpin the prosperity of the country and the wellbeing of its population. This has to be achieved within a framework that protects the water resources, as described in Part 1 of Chapter 3.

Water of naturally poor quality, which limits its utilisation, also occurs in some areas. This applies to both surface and groundwater. Where feasible, special management techniques may be applied to improve water quality to appropriate standards for particular uses.

Because attention in the past was mainly focused on the development of new resources as demand increased, partly since large unused potential was still available, efficiency in water use has not developed to the same level of sophistication as resource management. With the present high level of water resource utilisation in the country, water use efficiency must be substantially improved. The Department is developing an extensive programme for water conservation and water demand management, which forms an important element of the NWRS. In addition, measures are to be introduced to ensure the most beneficial utilisation of water in the country, both from a social and an economic perspective. These measures will include the re-allocation of some water from low benefit uses to higher benefit uses over time.

Provided that the water resources of South Africa are judiciously managed and wisely allocated and utilised, sufficient water of appropriate quality will be available to sustain a strong economy, high social standards and healthy aquatic ecosystems for many generations. The aim of the NWRS is to encourage and promote actions that ensure the long term sustainable and beneficial utilisation of the country's water resources.

2.3 WATER RESOURCES

South Africa depends mainly on surface water resources for most of its urban, industrial and irrigation requirements. In general, surface water resources are highly developed over most of the country. About 320 major dams, each with a full supply capacity exceeding 1 million cubic metres, have a total capacity of more than 32 400 million cubic metres (see Table 2.1), equivalent to 66 per cent of the total mean annual runoff. Groundwater, while also extensively utilised, particularly in the rural and more arid areas, is limited due to the geology of the country, much of which is hard rock. Large porous aquifers occur only in a few areas.

In the northern parts of the country (water management areas 1 to 5 and 8 to 10) both the surface and groundwater resources are nearly fully developed and utilised. Over-exploitation occurs in some localised areas. The reverse applies to the well-watered south-eastern region of the country (water management areas 11, 12 and 13) where there are still significant undeveloped and little-used resources.

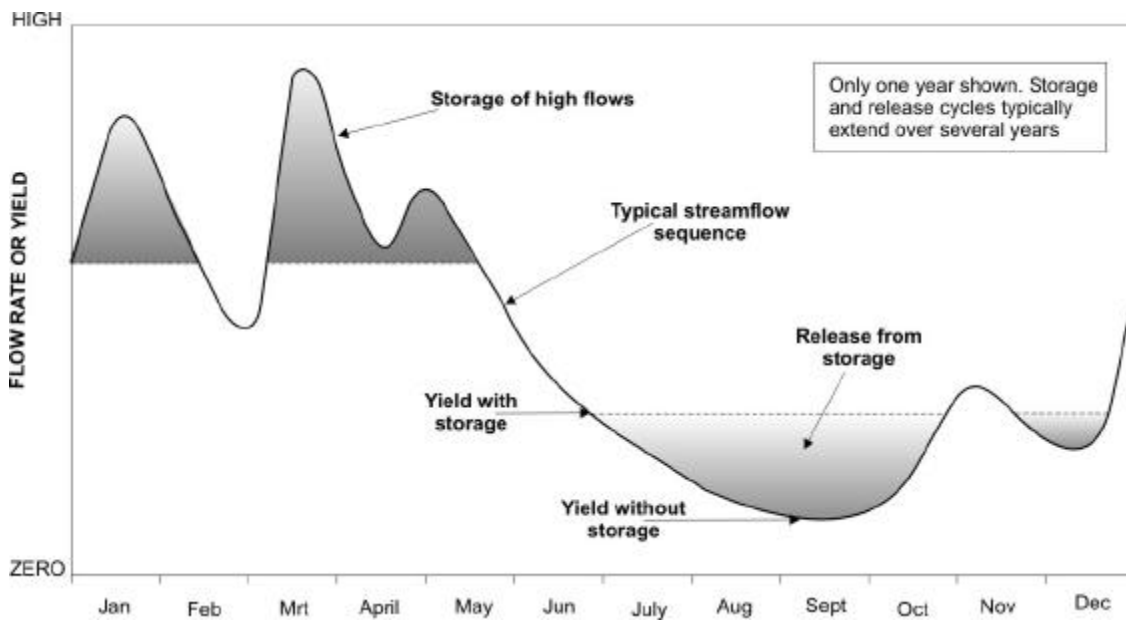
The total mean annual runoff of South Africa under natural (undeveloped) conditions is estimated at a little over 49 000 million m³/a, which includes about 4 800 million m³/a and 700 million m³/a of water originating from Lesotho and Swaziland respectively, which naturally drains into South Africa. The flows from neighbouring countries into rivers bordering on South Africa have been excluded, and the mean annual runoff thus represents the long-term average total renewable fresh water resources occurring in the country. A portion of this runoff needs to

remain in the rivers to satisfy the requirements for the ecological component of the Reserve^[3] (see Part 1 of Chapter 3), while only part of the remainder can practically and economically be harnessed as usable yield (see Box 2.1 for an explanation of “yield”).

Box 2.1: Yield, reliability, available water and assurance of supply

The yield from a water resource system is the volume of water that can be abstracted at a certain rate over a specified period of time (expressed in million m³/a for the purposes of the NWRS). For domestic, industrial and mining use water is required at a relatively constant rate throughout the year, whereas strong seasonality of use occurs with respect to irrigation. Because of the typically large fluctuations in stream flow in South Africa, as illustrated over a 12-month period in the diagram below, the highest yield that can be abstracted at a constant rate from an unregulated river is equal to the lowest flow in the river. By regulating stream flow by means of dams, water can be stored during periods of high flow for release during periods of low flow, as shown by the dotted lines on the diagram. This increases the rate at which water can be abstracted on a constant basis and, consequently, the yield. The greater the storage, the greater the yield that can be abstracted, within certain limits.

Diagrammatic presentation of stream flow and storage



Because rainfall, runoff and thus stream flow vary from year to year, low flows (and floods) are not always of the same duration and severity. The amount of water that can be abstracted without failure (the yield) therefore also varies from year to year. The amount of water that can be abstracted for 98 out of 100 years on average is referred to as *the yield at a 98 per cent assurance of supply*. Implicit in this is the acceptance that some degree of failure with respect to supplying the full yield will, on average, occur two years out of every 100 years. For a specific river and water resource infrastructure, the higher the assurance of supply required (or the smaller the risk of failure that can be tolerated), the smaller the yield that can be abstracted, and vice versa. For the purposes of the NWRS all quantities have been adjusted to a 98 per cent assurance, where applicable, to facilitate comparison and processing. This is necessary because yields or water requirements are not directly comparable when at different assurances of supply, but first need to be normalised to a common standard.

Available water refers to all water that could be available for practical application to desired uses. The total yield locally available includes the yield from both local surface water and groundwater resources, as well as contributions to the yield by usable return flows from the non-consumptive component of upstream water use in the area under consideration. Total water available includes the total local yield plus water transferred from elsewhere.

Also refer to the Introduction to Appendix D

A summary of the mean annual runoff and the estimated average annual requirements for the ecological component of the Reserve per water management area is given in Table 2.1, together with an estimate of the total storage capacity in large dams - full supply capacity exceeding 1 million cubic metres - in each area. In estimating the water available for abstraction it was assumed that maintaining the ecological flow requirements in drought conditions would be approximately equivalent to the impact of the ecological component of the Reserve on the yield^[4]. All quantities relate to a particular water management area only, that is, quantities reflect water that originates in that particular area. Where more than one water management area is located along the same river, such as along the Vaal and Orange Rivers, the quantities from upstream water management areas have to be added to those of the water management area under consideration to reflect the actual, cumulative situation for the management area under consideration.

Great efforts have been made since the 1920s to assess the potential of the country's water resources. Various techniques were applied and different sources of information were used, the results of which are documented in a wide range of departmental reports. The numerical data given with respect to yield and available water can therefore be accepted as being of relatively high reliability. However, the figures are subject to review in future as some of the influencing factors change and as new extreme climatic events are observed over time. There is also evidence that the underlying patterns of the water cycle may be changing as a result of climate change, which may cause additional variation. In this manner, the database gradually expands to provide a more reliable assessment of resources. It is for this reason that the statistics on mean annual runoff given in Table 2.1 are slightly at variance with information published previously (also refer to section 2.4.1 below).

Quantification of the water requirements for the ecological component of the Reserve, while also soundly founded, is based on the currently still incomplete understanding of the functioning of ecosystems and their habitat requirements. These figures are therefore subject to improvement as better insights are gained through monitoring, studies and improved assessment methodologies. As reflected in Table 2.1, current provisional assessments indicate that, as a national average, about 20 per cent of the total river flow is required as ecological Reserve, which needs to remain in the rivers to maintain a healthy biophysical environment. This proportion, however, varies greatly across the country, from about 12 per cent in the drier parts to around 30 per cent in the wetter areas. Owing to a lack of better factual data it has provisionally been assumed that provision of the ecological water requirements in the lowest reach of a river will be sufficient to meet estuarine freshwater requirements as well.

The component of the Reserve required for basic human needs has to be abstracted from the water resource, and is therefore catered for under water requirements in Section 2.4.

In addition to appropriate quantities of water being made available for use, it is also essential for water to be of a suitable quality for a particular use, either for human and economic purposes or for the maintenance of ecosystems. Pollution of surface water occurs when too much of an undesirable or harmful substance is discharged into a resource, so that the natural assimilative capacity of the resource is exceeded and the water is rendered unfit for subsequent uses. The deterioration of the quality of surface water resources is one of the major threats to South Africa's capability to provide sufficient water of appropriate quality to meet its needs and to ensure environmental sustainability. Pollution of groundwater occurs where harmful substances, in excess of the natural assimilative capacity of the soils overlying the aquifer system, infiltrate into the ground and come into direct contact with underground water. Such pollution is of particular concern because it is difficult, costly and time consuming to rehabilitate (also refer to Box 2.2 on Water Quality). Water quality management therefore forms an integral part of the strategy for water resource management, as discussed in more detail in Part 2 of Chapter 3.

Table 2.1: Natural mean annual runoff and the ecological Reserve (million m³/a) and storage in major dams (million m³)

Water Management Area	Natural Mean Annual Runoff (1)	Ecological Reserve (1, 2)	Storage in major dams (3)
1 Limpopo	986	156	319
2 Luvuvhu/Letaba	1 185	224	531
3 Crocodile West and Marico	855	164	854
4 Olifants	2 040	460	1 078
5 Inkomati (4)	3 539	1 008	768
6 Usutu to Mhlatuze (5)	4 780	1 192	3 692
7 Thukela	3 799	859	1 125
8 Upper Vaal	2 423	299	5 725
9 Middle Vaal	888	109	467
10 Lower Vaal	181	49	1 375
11 Mvoti to Umzimkulu	4 798	1 160	827
12 Mzimvubu to Keiskamma	7 241	1 122	1 115
13 Upper Orange (6)	6 981	1 349	11 711
14 Lower Orange (7)	502	69	298
15 Fish to Tsitsikamma	2 154	243	739
16 Gouritz	1 679	325	301
17 Olifants/Doring	1 108	156	132
18 Breede	2 472	384	1 060
19 Berg	1 429	217	295
Total for South Africa	49 040	9 545	32 412

- 1) Quantities refer to the water management area under consideration only, thus water originating in that water management area.
- 2) Total volume, based on preliminary estimates. The impact on yield will be smaller than this number.
- 3) Includes dams constructed to end-2003 with capacity exceeding 1 million cubic metres, but excludes dams constructed solely for flood control (Qedusizi in WMA 7 and Beervlei in WMA 15). Accounts for accumulated sediment according to most recent surveys and includes dead storage
- 4) Includes the Komati catchment in Swaziland (mean annual runoff = 517 million m³/a).
- 5) Includes the Pongola catchment in Swaziland (mean annual runoff = 213 million m³/a).
- 6) Storage includes Katse and Mohale dams in Lesotho.
- 7) Includes contributions from the Senqu and Caledon Rivers in Lesotho (mean annual runoff = 4 765 million m³/a).

Major sources of pollution of surface waters are agricultural drainage and wash-off (irrigation return flows, fertilisers, pesticides and runoff from feedlots), urban wash-off and effluent return flows (bacteriological contamination, salts and nutrients), industries (chemical substances), mining (acids and salts) and areas with insufficient sanitation services (microbial contamination). Pollution of groundwater results from mining activities, leachate from landfills, human settlements and intrusion of sea water.

The relevant contributions of different components (surface water, groundwater and return flows) to the available yield in each of the water management areas are indicated in Table 2.2. It should be noted that substantial volumes of water are returned to streams after use, and are then available for re-use, provided that the quality of the return flows satisfy the relevant user requirements. In fact, the total usable return flows are close to double the current yield from groundwater. The negative yields from surface water in the Middle Vaal, Lower Vaal and Lower Orange water management areas reflect the fact that river losses due to evaporation and seepage are greater than the additional yield contributed by local runoff in these areas.

According to estimates of undeveloped resource potential, the yield from surface water can be increased by about 5 400 million m³/a by further resource development. This estimate excludes possible developments which are unlikely to be economically viable or of otherwise doubtful feasibility. In addition, substantial quantities of water could become available by increasing the re-use of return flows. There is specific potential for this at some coastal cities, where wastewater is at present discharged to the sea. The potential also exists for further groundwater development, although generally on a smaller scale than the other options. In many instances groundwater exploitation could also have an impact on surface water availability. More detailed information on the groundwater situation in South Africa, as well of groundwater/surface water interdependencies, is given Box 2.3.

Desalination of seawater offers particular opportunities for coastal users. Although generally still more expensive than developing (and transferring) surface resources, the technology is tending to become more competitive as a result of advances in the field, particularly through the introduction of more cost-efficient membrane technologies. Desalination is practised on a large scale in many Middle Eastern countries and specific local situations exist in South Africa where small-scale desalination has proved to be more cost-effective than transporting fresh water over long distances.

Consideration has in the past been given to other options and less-conventional sources to augment water supplies in South Africa. These include the importation of water from, for example, the Zambezi River, rainfall augmentation by cloud seeding, the shipping of fresh water from the mouths of large rivers and towing icebergs to South Africa. Although most of these ideas are technically feasible, there are various degrees of environmental, political and legal considerations attached to each one. Based on current scientific understanding and cost structures, it is not anticipated that any of these options will be competitive at a significant scale compared to the options discussed under section 2.5, particularly within the time frame of the first edition of the NWRS.

Table 2.2: Available yield in year 2000 (million m³/a) (1)

Water management area	Natural Resource		Usable return flow			Total local yield
	Surface water (2)	Ground water (3)	Irrigation	Urban	Mining and bulk industrial	
1 Limpopo	160	98	8	15	0	281
2 Luvuvhu/Letaba	244	43	19	4	0	310
3 Crocodile West and Marico	203	146	44	282	41	716
4 Olifants	410	99	44	42	14	609
5 Inkomati	816	9	53	8	11	897
6 Usutu to Mhlatuze	1 019	39	42	9	1	1 110
7 Thukela	666	15	23	24	9	737
8 Upper Vaal	598	32	11	343	146	1 130
9 Middle Vaal	(67)	54	16	29	18	50
10 Lower Vaal (3)	(54)	126	52	0	2	126
11 Mvoti to Umzimkulu	433	6	21	57	6	523
12 Mzimvubu to Keiskamma	777	21	17	39	0	854
13 Upper Orange	4 311	65	34	37	0	4 447
14 Lower Orange (4)	(1 083)	24	96	1	0	(962)
15 Fish to Tsitsikamma	260	36	103	19	0	418
16 Gouritz	191	64	8	6	6	275
17 Olifants/Doring	266	45	22	2	0	335
18 Breede	687	109	54	16	0	866
19 Berg	403	57	11	37	0	505
Total for country	10 240	1 088	675	970	254	13 227

- 1) Transfers into and out of water management areas are not included above, but are covered in Table 2.4
- 2) Yield from run-of-river and existing storage, after allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.
- 3) Estimated use from existing boreholes and springs. As a result of development of groundwater for irrigation since the compilation of the database for the NWRS, total groundwater use may exceed this estimate. The increase is mainly due to growth in irrigation water requirements, and therefore does not significantly impact on the overall water balances given in the NWRS.
- 4) Negative figures under surface water caused by river losses being larger than the incremental runoff from within the water management area.

Box 2.2: Water quality

Water quality refers to the physical, chemical and biological characteristics of water. It describes how suitable the water is for its intended purpose in nature or for use by different water users. Different ecosystems and different user groups can have widely variable water quality requirements. The quality of water to maintain trout streams is not the same as that needed for irrigation, which is also not the same as that needed for drinking water or other purposes.

The factors influencing water quality can either be natural or result from human activity. The main natural factor that influences the quality of water is the geology of the formations over which water flows or through which it percolates, which gives rise to sediment load and mineralisation of the water. Vegetation, the slope of the land and flow rate may also influence water quality. The impacts of human activity on water quality are more varied and complex. Diffuse pollution results from various land use activities; most significantly agricultural practices and human settlements as well as the precipitation of pollutants from the air. Point sources of pollution typically are where urban, industrial and mining effluent is discharged to streams other and receiving waters. Water resource management interventions such as diversion, storage and inter-catchment transfer of water also impact on water quality.

Physical characteristics (mainly temperature, sediment load and turbidity) impact on aquatic life, recreational uses and the treatment of water for other uses. The main impacts of chemicals in the water relate to salinisation (dissolved salts) which may render water unfit or very costly to treat for application to many uses such as irrigation and household use. Eutrophication, which is the enrichment of water with plant nutrients, gives rise to excessive growth of macrophytes and microscopic plants such as algae and cyanobacteria in rivers and reservoirs. Cyanobacteria (often referred to as blue-green algae) is toxic, and may cause the water to be unfit for recreational, irrigation and domestic use.

Pollution by metals and manufactured organic components such as herbicides and pesticides is also becoming an increasing problem in South Africa due to industrialisation, and can have serious impacts on human and animal health. Microbial contamination, arising mainly from untreated sewage entering water resources due to poorly maintained or a lack of sanitation services, poses a widespread problem in South Africa, carrying pathogens that may cause water borne diseases such as diarrhoea and cholera.

The main activities that can contribute to the determination of water quality are mining (acidity and increased metals content); urban development (salinity, nutrients, microbiological); industries (chemicals, toxins), and agriculture (sediment, nutrients, agro-chemicals, salinity through irrigation return flows). The pollution of surface waters is generally more common and noticeable than with regard to groundwater. In contrast pollution of groundwater is often not readily detectable and may be very difficult, costly and time-consuming to remedy. More detail on water quality management is given in section 3.2.4.

A general perspective on the water management areas in which physico-chemical water quality characteristics may be outside the ideal ranges is given in the table below.

	Water management area	Domestic use								Irrigation use				Recreational Use
		F	TDS	Ca	Mg	SO ₄	Cl	Na	K	SAR	EC	pH	Cl	
1	Limpopo													
2	Luvuvhu / Letaba										(+)			
3	Crocodile West & Marico										(+)			X
4	Olifants	X									L	(+)		X
5	Inkomati													
6	Usutu to Mhlathuze						X				L	(+)	L	
7	Thukela													X
8	Upper Vaal					X								X
9	Middle Vaal													X
10	Lower Vaal													X
11	Mvoti to Umzimkulu													X
12	Mzimvubu to Keiskamma											(+)		X
13	Upper Orange		X					X				(+)		
14	Lower Orange		X					X		L	M	(+)	M	X
15	Fish to Tsitsikamma		X	X		X	X	X		L	LMH	(-) (+)	LMH	X
16	Gouritz		X	X	X	X	X	X	X	LM	H	(-)	H	
17	Olifants / Doring													
18	Breede						X				L		L	X
19	Berg													

Key

Domestic use: X indicates that the water quality indicator is outside the ideal range for domestic use at some locations in the water management area.

F = Fluoride; TDS = Total dissolved salts; Ca = Calcium; Mg = Magnesium; SO₄ - Sulphate; Cl = Chloride; Na = Sodium; K = Potassium.

Irrigation use: A symbol indicates that the water quality indicator is outside the target water quality range for irrigation use at some locations in the water management area, where L, M and H means Low, Medium or High risk, (+) = alkaline and (-) = acidic.

SAR = Sodium Adsorption Ratio; EC = Electrical Conductivity; pH = a measure of acidity/alkalinity; Cl = Chloride; b = Boron.

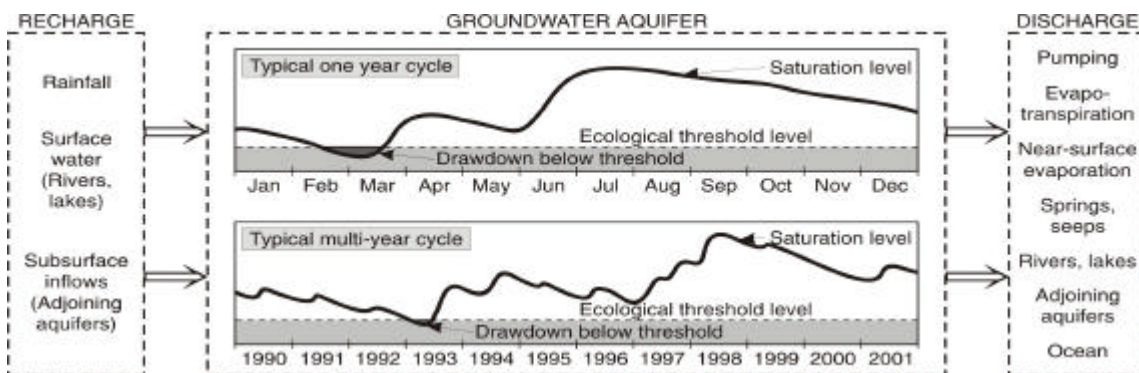
Recreational Use: X indicates that the water quality indicator is occasionally outside the acceptable levels for recreational use at some locations because toxic cyanobacteria have been found.

Box 2.3: Groundwater

Groundwater and surface water are different occurrences of the same resource. The interactions between the two, the effects on one of using the other, and the role of groundwater in supporting ecosystem functioning are imperfectly understood. However, some general information on the nature and role of groundwater should help to clarify this situation.

Excluding water locked in the polar ice caps, groundwater constitutes about 97% of all fresh water on Earth. The remainder occurs in lakes, rivers and swamps. Although groundwater is not abundant in South Africa because of the predominantly hard rock geology, it is relatively easily accessible throughout the country and is a vital source of supply to many users. Groundwater is extensively used for rural domestic purposes, stock watering, water supply to villages and smaller towns as well as irrigation in localised areas. In general it can be found within reasonable distance from where it is required throughout most of South Africa, and therefore constitutes a primary source of water over much of the country.

Groundwater replenishment - recharge - is primarily from rainfall, but also occurs through seepage from other water bodies. Depending on the magnitude of the recharge event, groundwater levels respond in a typical rising trend followed by a steady, long-term decline as a result of discharge from the system (see diagram below).



Diagrammatic representation of aquifer saturation level (water table) response to recharge and discharge

Natural discharge in the form of river baseflow, seepage and evapo-transpiration from plants could be linked to groundwater's ecological support. The balancing role of regional groundwater storage is of great importance for both natural and managed water resource systems, whilst there also is a growing recognition of the ecological importance of groundwater, particularly where it links to groundwater-dependent ecosystems. Additional lowering of the groundwater table by means of abstraction (through pumping) beyond its ecological threshold level will impact on the ecological services of the system, which includes estuaries, wetlands and springs.

The Annual Harvest Potential, derived from an evaluation of the mean annual recharge of groundwater (adjusted for drought period rainfall), gives an indication of the maximum volume of groundwater that may be abstracted without depleting the aquifers, although some natural discharge functions may be impacted. The Harvest Potential for the whole of South Africa was estimated at 19 000 million cubic metres per year (Mm^3/a). Of this, approximately 6 000 Mm^3/a , stored as general recharge, could be abstracted without impacting on surface water resources. Although a substantial quantity of groundwater therefore appears to be available for use it occurs mainly as a diffuse source in many separate aquifers. Only that part which occurs in suitable quantities at locations where demands exist, and where its use will be economically feasible or socially justifiable will eventually be abstracted.

Estimates of present groundwater use in each water management area are given in Table 2.2. No separate allowance was made in Tables 2.5 and 2.6 for the potential future development of groundwater. Instead, the potential given for development is a conservative estimate of the combined potential for both surface and groundwater, primarily based on the more readily quantifiable surface resource potential.

Consideration also needs to be given to the quality of groundwater and to what extent it conforms to user requirements. Groundwater may be too mineralised for direct use without treatment, particularly in the drier parts of the country. However, the use of groundwater conjunctively with surface waters also offers significant potential benefits as it facilitates the optimal blending of the most wanted characteristics from both components.

Optimal management and utilisation of groundwater resources will require improved capacity to assess groundwater potential and monitor trends, and a better understanding of aquifer functioning, the interactions between surface and groundwater and the impacts of groundwater use on ecological functioning. Proposals to expand and refine the groundwater monitoring and assessment system are outlined in Part 6 of Chapter 3.

2.4 WATER REQUIREMENTS

For the judicious management of water resources an appropriate knowledge and understanding of the requirements for water is as essential as knowledge of the resource itself. A factor that compounds the already complex water resource situation in South Africa is the large variation in water requirements across the country, which is similar to the variation that exists with regard to the availability of water resources. In addition to differences in the requirements of the various water use sectors relating to quantity, quality, temporal distribution and assurance of supply, divergent social and economic values associated with water and abilities to pay have to be taken into account. In addition, a variety of external factors can impact on growth rates. Importantly, certain priorities with regard to the provision of water also need to be recognised, relating to the primary roles of water in sustaining life, and in supporting social and economic development.

For the purposes of the NWRS information and statistics are provided here with respect to the main user sectors. The ecological component of the Reserve is not included as a use since it is allowed for as a part of the resource that may not be abstracted (refer to section 2.3). Water to meet international obligations is covered in section 2.7.2. It is not included as a user sector as it does not constitute an internal use of water in South Africa, but is accounted for in the reconciliation tables (Tables 2.4, 2.5 and 2.6). The water use sectors that are covered are the following -

- Rural requirements, which mainly represent domestic use and stock watering requirements in rural areas.
- Urban requirements, which include all water used in urban areas for domestic, industrial, commercial, parks and other communal purposes.
- Mining and bulk users, representing large mining and industrial users abstracting directly from the resource or bulk supply systems, not from municipal systems.
- Power generation (also refer to water use of strategic importance under section 2.7.3).
- Irrigation for agricultural production.
- Afforestation, as a formally declared stream flow reduction activity (see Part 2 of Chapter 3).
- Transfers of water out of a particular area, which constitutes a requirement for water from that area. (These are not shown as a requirement in Table 2.3, but are included in the reconciliation tables).

The provision of water for basic human needs (the human component of the Reserve) is included under rural and urban requirements and is taken as the first 25 litres/person/day of these requirements.

2.4.1 Current water requirements

The base data on water requirements was obtained through a series of country-wide situation assessments. Data was obtained from a wide range of sources, and various methods were used for its verification and enhancement.

Estimated water requirements for the year 2000 for the different water use sectors, standardised to the equivalent quantities at a 98 per cent assurance of supply for the purposes of direct comparison, are given in Table 2.3 (refer to Box 2.1 for an explanation of assurance of supply). In many cases, such as for certain irrigation practices, considerably more water than indicated in the table is abstracted when it is available, but on the understanding by the user that there is a high risk of inadequate water being available in some years. Although the statistics are acceptable for the purposes of the NWRS, their accuracy varies significantly among user sectors as well as geographically. Uncertainties exist in particular with regard to the quantities of water abstracted for irrigation and, as this sector represents more than half of the country's total water use, it will be receiving particular attention in the relevant programmes of the Department.

Table 2.3: Water requirements for the year 2000 (million m³/a)

Water management area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Afforestation (4)	Total local requirements
1 Limpopo	238	34	28	14	7	1	322
2 Luvuvhu/Letaba	248	10	31	1	0	43	333
3 Crocodile West and Marico	445	547	37	127	28	0	1 184
4 Olifants	557	88	44	94	181	3	967
5 Inkomati	593	63	26	24	0	138	844
6 Usutu to Mhlathuze	432	50	40	91	0	104	717
7 Thukela	204	52	31	46	1	0	334
8 Upper Vaal	114	635	43	173	80	0	1 045
9 Middle Vaal	159	93	32	85	0	0	369
10 Lower Vaal	525	68	44	6	0	0	643
11 Mvoti to Umzimkulu	207	408	44	74	0	65	798
12 Mzimvubu to Keiskamma	190	99	39	0	0	46	374
13 Upper Orange	780	126	60	2	0	0	968
14 Lower Orange	977	25	17	9	0	0	1 028
15 Fish to Tsitsikamma	763	112	16	0	0	7	898
16 Gouritz	254	52	11	6	0	14	337
17 Olifants/Doring	356	7	6	3	0	1	373
18 Breede	577	39	11	0	0	6	633
19 Berg	301	389	14	0	0	0	704
Total for country	7 920 62%	2 897 23%	574 4%	755 6%	297 2%	428 3%	12 871

- 1) Includes the component of the Reserve for basic human needs at 25 litres/person/day.
- 2) Mining and bulk industrial that are not part of urban systems.
- 3) Includes water for thermal power generation only, since water for hydropower, which represents a small portion of power generation in South Africa, is generally also available for other uses. (For ease of direct comparison with Eskom these numbers have not been adjusted for assurance of supply; the quantitative impact of which is not large).
- 4) Quantities given refer to impact on yield only. The incremental water use in excess of that of natural vegetation is estimated at 1 460 million m³/a.

Comparison of the statistics contained in this document with information published by the Department previously will reveal what appear to be significant discrepancies in both the available yield and in water requirements. These can be attributed to differences in some primary assumptions, revised definitions, the standardisation of yield and requirements to a common assurance of supply, and new sources of data becoming available. A reconciliation of information contained in the NWRS with that published in the *Overview of Water Resources Availability and Utilisation in South Africa* (1997) is given in Box 2.4.

Comparison of the requirements in Table 2.3 with the corresponding return flows in Table 2.2 provides an indication of the extent to which water use is consumptive. On average, usable return flows from the rural, irrigation, urban and mining/bulk sectors are estimated at 0, 9, 33 and 34 per cent respectively. Only a portion of the water used non-consumptively becomes available for re-use, with large quantities of effluent return flows, particularly from urban and bulk industrial users in coastal areas, being discharged to the ocean. Water use in the rural areas, as well as for irrigation and thermal power generation, is predominantly consumptive.

Agricultural irrigation represents more than 60 per cent of the total water requirements in the country, urban requirements constitute about 23 per cent and the remaining 15 per cent is shared by the other four sectors (all standardised to 98 per cent assurance of supply).

Fig. 2.4 gives the relative contribution of different economic sectors to the national economy. Although the economic sectors do not correspond directly to water use sectors, valuable insights can nevertheless be gained from this comparison. Particularly noteworthy from a water resources perspective is the fact that the direct contribution of the agricultural sector to the gross domestic product (GDP) is only about 4.5 per cent. Of this percentage only an estimated 25 to 30 per cent is from irrigated agriculture. Therefore, even though irrigation represents about 60 per cent of the total water use, its contribution to the gross domestic product is less than 1.5%. The remaining percentage comprises rain fed cultivation and livestock farming, and afforestation.

It is important though, that the sectoral contributions to the GDP are not viewed as an absolute indicator because of the strong linkages and inter-dependencies that exist among economic sectors. The agricultural sector in particular has strong forward linkages by supplying raw materials as inputs to other primary and secondary sectors. In 1985 approximately 58% of the total value of agricultural production was delivered as raw materials to processing plants, which contributed about 8,5% to the total value of industrial production. Agriculture also creates a strong demand for goods and services, such as fertiliser, machinery and financial services through its backward linkages. In total, agriculture was estimated to support approximately 25% of the manufacturing sector's contribution to the GDP. In some areas as much as half of some key multipliers from the agricultural sector have effects in areas remote from the primary agricultural activities. Similar considerations also apply to other primary sectors such as mining, and to a greater or lesser extent to all components of the economy.

The general indications, however, are that the economic impact per unit of water used in at least some parts of irrigated agriculture is substantially less than in other sectors. It will be necessary to obtain additional reliable information in this regard, and take it into account in the formulation of catchment management strategies, where the target should be to strive for the overall most beneficial use of water.

Additional perspective is gained when comparing the proportionate employment per economic sector, as shown in Fig. 2.5 with respect to those formally employed in 1994. Employment by the agricultural sector (irrigation and rain fed farming combined) accounted for about 11 per cent of total national employment, which is significantly higher than the proportionate economic production of this sector, reflecting the relative labour intensiveness of agriculture. The same applies to the construction, government and community sectors. In contrast, the manufacturing,

Box 2.4: Reconciliation of information given in the NWRS with information published previously

Significant differences appear to exist when direct comparisons are made between information given in the NWRS and that published in 1997 in the *Overview of Water Resources Availability and Utilisation in South Africa*. A summary of the main differences and the reasons for them follows.

Reference date

The *Overview* report used 1996 data as a reference base and also gave a high water use scenario for the year 2030. In the NWRS the year 2000 is used as reference date, with a base as well as a high projection of water requirements for the year 2025.

Mean annual runoff

Based on the availability of longer records and improved assessments of stream flow, a slight adjustment to the mean annual runoff has been made, from 50 150 million m³/a in the *Overview* report to 49 040 million m³/a in the NWRS. (If only water that originates in South African territory is considered, the mean annual runoff is estimated to be 43 500 million m³/a).

Water requirements

The total water requirements for South Africa are stated as being 20 045 million m³/a in the *Overview* (at 1996 development levels), compared to 12 871 million m³/a in the NWRS (at year 2000 reference date). These figures are not directly comparable, however, because of different approaches and definitions. In the *Overview* report environmental water requirements were included with the other water use sectors. In the NWRS it is argued that water for environmental purposes should remain in the rivers where it is actually needed. The NWRS therefore accounts for environmental requirements as a reduction in the yield of a water resource rather than as the abstractable or out-of-river requirements of other water use sectors. Furthermore, the water requirements given in the *Overview* report represent the combination of estimated actual requirements by different user groups (by sector and geographic area) without any adjustments having been made with respect to the assurance of supply (also refer to Box 2.1), whereas all the requirements in the NWRS have been standardised to a 98 per cent assurance of supply. It is typical, for example, for large quantities of water to be used for irrigation when it is available, even though it is accepted that it is at a low assurance of supply. In some parts of the country larger areas are also planted when water is available, whilst some of that land may lie fallow for several years during dry periods. In the calculations for the NWRS irrigation water requirements were based on the areas that would generally be under irrigation and are given at the standard 98 per cent assurance of supply.

After making adjustments according to the above to prove a direct comparison, and allowing for growth in demand between 1996 and 2000, the water requirements in the *Overview* report would amount to 13 700 million m³/a.

Although this figure is quite similar to the 12 871 million m³/a of the NWRS, differences still occur with respect to specific sectors and geographic areas. These are attributable to continuous improvements being made to the databases.

Yield potential

In the *Overview* report, a maximum yield potential of 33 000 million m³/a is given, compared to about 20 000 million m³/a in the NWRS. Similar to the situation with water requirements, adjustments need to be made to environmental requirements and assurance of supply, which reduce the estimate in the *Overview* report to about 26 000 million m³/a.

The still lower estimate of yield potential in the NWRS is attributable to the fact that the purpose of the estimate in the *Overview* report was to give a theoretical ceiling value. The NWRS, in contrast, reflects the current greater sensitivity to environmental sustainability and also excludes developments of doubtful economic viability.

Figure 2.4: Sectoral contributions to the GDP (1997)

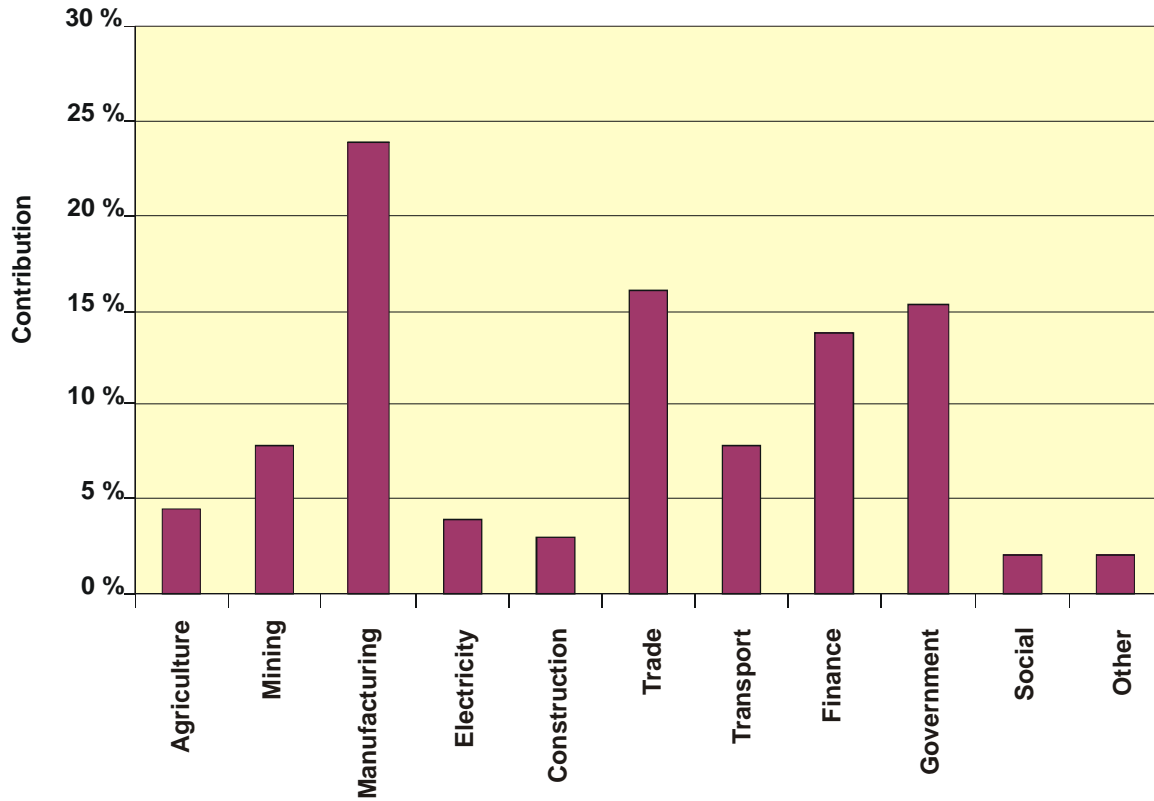
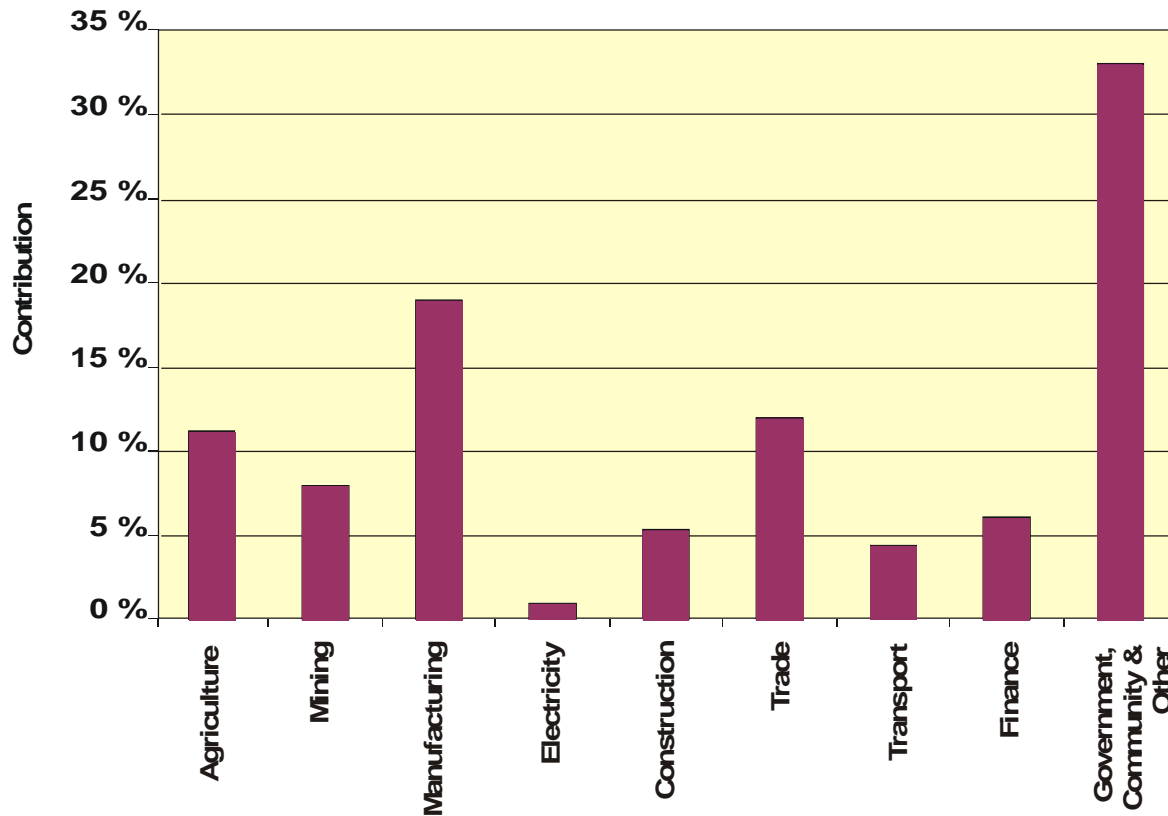


Figure 2.5: Formal employment per sector (1994)



electricity, trade, transport and finance sectors offer less employment per unit of economic production than the national average, with mining being neutral.

For irrigated agriculture only, employment is just over 1.5 per cent of the national total (10 to 15 per cent of the total agriculture sector), which is similar to its contribution to GDP. Employment per unit of economic production with respect to irrigation farming is thus close to the national average for all sectors of the economy and is substantially less than for agriculture as a whole. The same applies to employment opportunities per unit of capital invested. Whereas the employment/capital ratio is comparatively high for the total agricultural sector, irrigated agriculture does not hold above average employment creation advantages. This reflects the capital intensive nature of modern irrigation farming.

2.4.2 Future water requirements

There are many factors that influence the requirements for water in South Africa. These include climate, the nature of the economy (i.e. irrigated agriculture, industrialisation) and standards of living. Of these, climate has in the past been a relatively stable factor (but see Box 2.10 for a discussion of the possible implications of global climate change), while in most cases control can be exercised over the growth in demand for irrigation water. However, population, standards of living and economic activity have their own inherent growth rates and each is dependent on a wide spectrum of external influences. Population and economic growth relate to socio-economic standards, and are therefore regarded as the primary determinants with respect to future water requirements.

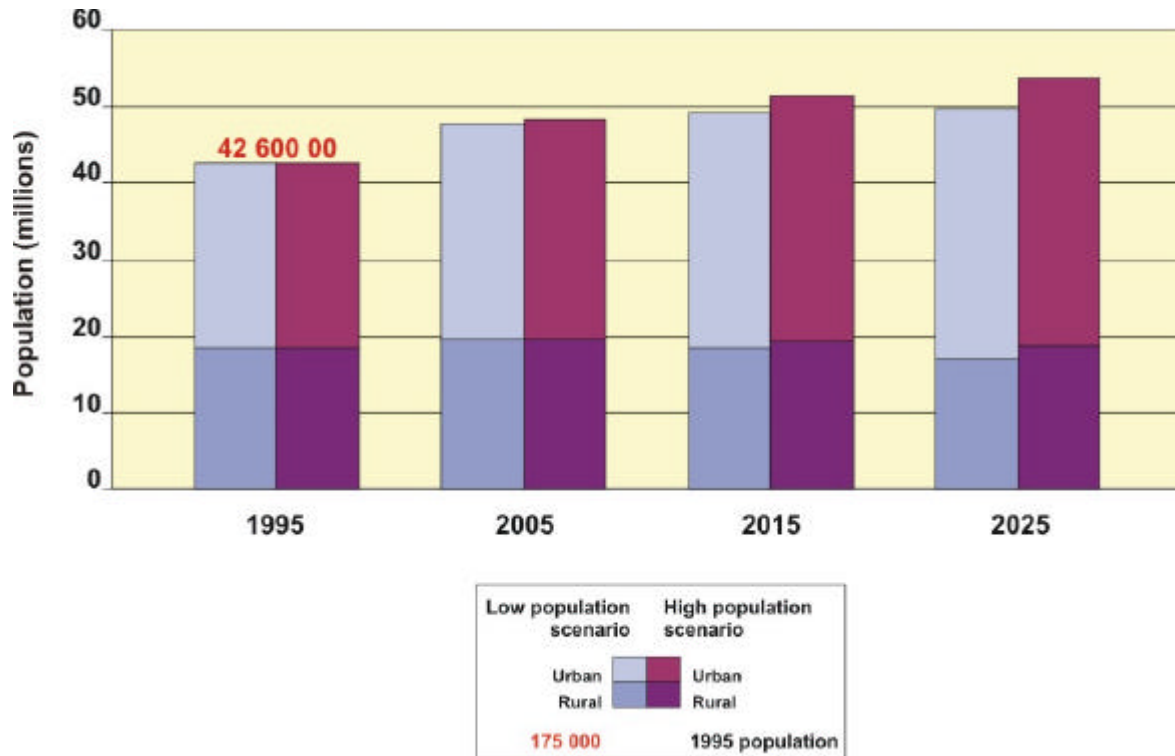
Projections of population growth and the future distribution of people between urban and rural areas and different regions is not a simple matter. Changes in national policies since 1994 in combination with the influence of global economic trends on South Africa have stimulated migration to certain areas and population declines in others. Specifically evident are the strong urbanisation trend and the negative impact of HIV/AIDS. Recognising that the future will not be a simple extension of the past, a detailed study of the expected demographic and socio-economic changes in the country, and the associated impacts on water requirements, was conducted to serve as background to the NWRS. The main outcome was the expectation of lower population growth rates than previously, mainly due to the impact of HIV/AIDS, as well as reduced reproduction rates linked to urbanisation and economic growth. The high and low population scenarios that were developed are shown diagrammatically in Fig. 2.6. Evident from the diagram is a slowing in the population growth rate in later years and small to negative growth in the rural population.

Estimates of the future population^[5] were initially made for the country as a whole, and then subdivided into smaller geographic units to facilitate the estimation of future water requirements on a regional basis. Because of the trend towards urbanisation and the expected stronger economic growth in the major urban and industrial centres, the greatest long-term uncertainty about future water requirements exists in these user sectors. Greater attention was therefore given to the main urban centres in the subdivision of population, with less substantiation of the population projections for smaller centres and some rural areas. The population projections for the latter areas will need to be examined in more detail during the development of catchment management strategies.

Scenarios were also developed for economic growth, and for the influence of economic growth on future water requirements, in an attempt to narrow the uncertainties which the future holds. Multi-variate analyses were performed in order to develop scenarios of possible low and high economic growth for different geographic regions in the country. Gross Geographic Product (GGP) was considered the most relevant economic indicator for the purposes of the NWRS because of relationships that can be established to water usage. The outcome was an upper scenario of average real growth in GDP of over 4 per cent per year for the period up to 2025, and a less favourable low growth scenario of roughly 1.5 per cent per year. In general, economic growth is expected to be substantially higher in the larger urban and industrialised areas and

those which are favourably located with respect to resources and transportation routes than in the rural areas. Consideration was given to the trend towards growth in service and manufacturing industries, and the expected impact of changing trade patterns on manufacturing, transport infrastructure and export facilities.

Figure 2.6: Diagrammatic presentation of anticipated population growth (RSA total)



Based on these scenarios, initial estimates of possible future water requirements were made until the year 2025. Eskom's projections of future water requirements for power generation were added. Provision was also made for known and probable future developments in irrigation, mining and bulk use, as described under the respective water management areas in Appendix D. (Specific quantities, rather than general annual growth rates, were allowed for in these sectors.)

Apart from the requirements for water in the established user sectors, which can be calculated with relative ease, the quantities of water required for redressing inequities and poverty eradication will depend strongly on the specific requirements of local and regional development strategies. Such water requirements are difficult to project, and quantitative allowances were made only where sufficient information was available. However, through appropriate application of the reconciliation strategies given in the NWRS (refer to Part 2.5, Chapter 3 and Appendix D), sufficient resources could be made available to meet all priority requirements for water.

Given the general trends in the country towards urbanisation and continued economic growth, future growth in water requirements is expected to occur in the economically more favourably located urban areas. (Caution should, however, be exercised not to misinterpret temporary migration from rural areas to towns as a long term sustainable growth of population in these areas, as this may be an interim step towards migration to the larger cities). Relatively strong growth is also foreseen in the mining sector, with water demand for mineral exploitation anticipated principally in the northern regions of the country.

Within the spectrum of population and economic growth scenarios, a base scenario was selected for estimating the most likely future water requirements. This comprises the high scenario of population growth together with higher average levels of urban domestic water

requirements^[6] resulting from a more equitable distribution of wealth. The ratio of domestic to commercial, communal and industrial water use for urban centres in the year 2000 is maintained. A possible upper limit scenario is also proposed. This scenario is based on the same assumption of high population growth and a high standard of service provision flowing from rapid socio-economic development, with the distinction that these are combined with strong economic growth in which commercial, communal and industrial water use increases in direct proportion to growth in GDP. The upper scenario is intended to serve as a conservative indicator to prevent the occurrence of possible unexpected water shortages. Figures for both scenarios are presented in section 2.5. No adjustments have been made to reflect the impact increased water use efficiency would have.

2.5 STRATEGIES TO BALANCE SUPPLY AND DEMAND (RECONCILIATION)

2.5.1 Current situation

A reconciliation of the available water and total requirements for the year 2000, including transfers between water management areas and to neighbouring countries, is given in Table 2.4. The transfer of water from the Upper Orange River to the Upper Vaal water management area via the Lesotho Highlands Water Project (LHWP) is reflected as being from the Upper Orange water management area. Consequently the table does not explicitly reflect the fact that water is being imported into South Africa from another country. The transfer of 170 million m³/a out of South Africa relates to water being delivered from the Crocodile West and Marico water management area to Gaborone in Botswana (7 million m³/a), the minimum flow released from the Inkomati water management area to Mozambique (109 million m³/a), and abstractions from the Orange River Project by Namibia (54 million m³/a). The bulk of the transfers is between water management areas, either by aqueducts or in the form of yield released along rivers. (Refer to Box 2.5 for an explanation of quantities relevant to the inter-catchment transfer of water).

Deficits exist in more than half of the water management areas, whilst a surplus still exists for the country as a whole. This demonstrates the regional differences in the country, and highlights the potential risks of generalisation. Similarly, a surplus or a deficit shown in a particular water management area is unlikely to be representative of the area as a whole, and anomalies are most likely to occur in some catchments or smaller areas within the water management area. Furthermore, the water availability and water balance figures are relevant to current water use patterns and the existing geographic occurrence of resources, abstractions and return flows. Often it is not practical or economically viable for water to be transferred from areas of surplus to areas of deficit (as demonstrated in Appendix D 2.3 with respect to the Crocodile West and Marico water management area). Imbalances within water management areas will be handled according to the catchment management strategies to be developed by catchment management agencies.

In addition, it should be noted that in many cases the deficits shown do not imply that present actual use exceeds the amount of water reckoned to be available, but that the allowances made for the implementation of the ecological component of the Reserve cannot be met fully at present levels of use. Whilst the requirements for the Reserve are only indicative at present and have not yet been implemented, it is prudent that all known and estimated requirements are included in the NWRS. This will help to ensure proper implementation management when the Reserve is formally brought into effect in catchments across the country. It is intended to follow a phased approach for the implementation of the Reserve, in order to minimise possible negative impacts on existing users.

**Table 2.4: Reconciliation of the requirements for and availability of water for year 2000
(million m³/a)**

Water management area	Reliable local yield	Transfers in (3)	Local requirements	Transfers out (3)	Balance (1, 2)
1 Limpopo	281	18	322	0	(23)
2 Luvuvhu/Letaba	310	0	333	13	(36)
3 Crocodile West and Marico	716	519	1 184	10	41
4 Olifants	609	172	967	8	(194)
5 Inkomati	897	0	844	311	(258)
6 Usutu to Mhlatuze	1 110	40	717	114	319
7 Thukela	737	0	334	506	(103)
8 Upper Vaal	1 130	1 311	1 045	1 379	17
9 Middle Vaal	50	829	369	502	8
10 Lower Vaal	126	548	643	0	31
11 Mvoti to Umzimkulu	523	34	798	0	(241)
12 Mzimvubu to Keiskamma	854	0	374	0	480
13 Upper Orange	4 447	2	968	3 149	332
14 Lower Orange	(962)	2 035	1 028	54	(9)
15 Fish to Tsitsikamma	418	575	898	0	95
16 Gouritz	275	0	337	1	(63)
17 Olifants/Doring	335	3	373	0	(35)
18 Breede	866	1	633	196	38
19 Berg	505	194	704	0	(5)
Total for country	13 227	0	12 871	170	186

- 1) Brackets around numbers indicate a negative balance.
- 2) Surpluses in the Vaal and Orange water management areas are shown in the most upstream water management area where they become available (that is, the Upper Vaal and Upper Orange water management areas.)
- 3) Transfers into and out of water management areas may include transfers between water management areas as well as to or from neighbouring countries. Yields transferred from one water management area to another may also not be numerically the same in the source and recipient water management area (refer Box 2.5). For this reason, the addition of transfers into and out of water management areas does not necessarily correspond to the country total. The same applies to Tables 2.5 and 2.6. The transfer of water from Lesotho to South Africa is reflected in the tables as being from the Upper Orange water management area (see also Appendix D 13.)

Nevertheless, in many areas current levels of use take no account of the need to sustain the ecological functioning of the resource, and substantial changes will have to be made when the Reserve is implemented. This situation is addressed in more detail for each water management area in Appendix D.

Existing surpluses will generally be taken up in the foreseeable future by growth in the domestic, urban, industrial and mining requirements for water. In a few instances – see Appendix D – existing surpluses may be applied beneficially to irrigation or afforestation.

Although not explicitly quantified, water quality must also be considered in the reconciliation under discussion here. For example, the surplus shown for the Fish to Tsitsikamma water management area in Table 2.4 is attributable to poor quality return flows from irrigation. This is volumetrically in excess of requirements at the estuary, but not of appropriate quality for most upstream uses without blending or treatment.

Box 2.5: Volumetric considerations in transferring water between catchments

Inter-catchment transfer schemes convey specific quantities of water that are physically measurable. The impact on the yields in both the source and the receiving catchments as a result of the water transferred is however dependent on complex inter-relationships and can differ substantially from the quantity of water transferred.

The yield of a water resource system (see Box 2.1) is determined by parameters such as stream flow characteristics, climate, the size and configuration of the water resource infrastructure, water use characteristics and land use, which are all unique to that specific water resource system. Transferring water from one catchment to another will change the flow characteristics in both catchments. The extent to which these characteristics will be affected will, amongst others, depend on the quantity transferred relative to the natural or prevailing flow in the respective water courses, the points of abstraction and discharge, variations in the rate of transfer and the assurance at which water is transferred.

Flow characteristics, however, constitute only one of the parameters determining the yield, and this, in turn, is subject to the interplay with all other influencing parameters that occur in different quanta and combinations in the source and recipient catchments. A prime example of how the above factors can contribute to cause impacts on yield that are different to the quantity transferred is offered by the Thukela-Vaal Transfer Scheme. In this case an average volume of 530 million m³/a is transferred from the Thukela River Basin (Thukela water management area) to the Vaal River Basin (Upper Vaal water management area) at a transfer rate that may vary from zero to the maximum capacity of 630 million m³/a. As a result of the transfer the residual yield from the Thukela System is reduced by 377 million m³/a. However, the impact on the Vaal River System is an increase in yield of 736 million m³/a. A change in any of the other parameters, such as the construction of a new dam, will likely affect the yields.

This example clearly demonstrates one of the advantages of transferring water and operating water resources in a systems context, namely that leverage can be applied to achieve a greater overall yield and utility from water resources.

The figures for yield given in Tables 2.4, 2.5 and 2.6, and in the corresponding series of tables in Appendix D, represent the impact on yield of relevant transfers. Because the impact of transfers on yield may be different in source and recipient catchments, addition of the figures for transfers in and out will not necessarily result in a total that balances. The quantities reserved for transfer as stipulated in Appendix D refer to the physical quantity of water that may be transferred (unless otherwise specified), and may differ from the impacts of the transfer.

Of the total requirements for water of 12 871 million m³/a approximately 9 500 million m³/a is abstracted from surface water resources. The remainder is supplied from groundwater, the re-use of return flows, and the interception of water by afforestation. Total requirements therefore represent approximately 20 per cent of the total mean annual runoff of 49 040 million m³/a . A further 8 per cent is estimated to be lost through evaporation from storage and conveyance along rivers, and 6 per cent through land use activities. For the country as a whole, approximately 66 per cent of the natural river flow (mean annual runoff) therefore still remains in the rivers. Typically, the temporal flow distribution of this remaining water has been significantly altered as a result of upstream regulation and use, and no longer reflects the natural stream flow characteristics. However, it substantially serves to meet the requirements of the Reserve and to honour downstream international commitments. Potential also exists for a portion of the remaining water to be abstracted for allocation to users, provided that sufficient infrastructure exists or can be developed. Should the surface resources be developed to the full potential regarded as feasible, more than 50% of the mean annual runoff will still remain in the rivers.

2.5.2 Future perspective

Tables 2.5 and 2.6 give a perspective on the possible future requirements for water, as well as the water that will potentially be available under the base and high scenarios respectively. This data serves as additional background to the development of national strategies and also provides strategic perspectives for the respective water management areas. The base scenario, which is regarded as the more probable, does not show pronounced deviation from the year 2000 situation. However, for both the base and high scenarios deficits are generally projected to increase and surpluses to diminish. (The growth in surplus for the Crocodile West and Marico water management area is the result of growing waste water return flows in the area - see also discussion below). Many problems of a more localised nature are masked by generalisation and will only be able to be identified through scrutiny of the more detailed information for individual water management areas and the catchments within them.

Dramatic growth in the main urban areas is projected under the high growth scenario, which is regarded as an upper extreme for testing the resilience of proposed strategic action plans. Of note is the growth in local yield with respect to the year 2025 scenarios, as compared to local yield in year 2000. This is as a result of projected increases in return flows from urban/industrial areas. Of specific importance is the substantial potential for resource development, principally through the construction of new storage dams, which exceeds the overall shortfall in the country, although the available water is often not in the desired locations. Potential also exists for further development of groundwater resources. In general though, the practically exploitable quantities are substantially smaller than for surface water. Furthermore, close interdependencies exist between surface and groundwater and development of the latter may impact on surface water availability (refer to Box 2.3 and the Introduction of Appendix D). The potential for resource development as given in Tables 2.5 and 2.6 should therefore be regarded as being representative of the total undeveloped resource potential for both surface and groundwater. In specific cases, where larger potential for groundwater development may exist, these are described under the relevant water management areas in Appendix D.

From the demographic projections, which also reflect the economic driving forces in the country, it is expected that future growth in water requirements will largely be in the main metropolitan centres. Apart from catchments already under stress, particular attention will therefore have to be given to ensuring adequate future water supplies to these areas, as well as ensuring equitable access to existing supplies.

Table 2.5: Reconciliation of requirements for and availability of water for the year 2025 base scenario (million m³/a)

Water management area	Reliable local		Local		Balance (3)	Potential for development (4)
	yield (1)	Transfers in	requirements (2)	Transfers out		
1 Limpopo	281	18	347	0	(48)	8
2 Luvuvhu/Letaba	404	0	349	13	42	102
3 Crocodile West and Marico	846	727	1 438	10	125	0
4 Olifants	630	210	1 075	7	(242)	239
5 Inkomati	1 028	0	914	311	(197)	104
6 Usutu to Mhlathuze	1 113	40	728	114	311	110
7 Thukela	742	0	347	506	(111)	598
8 Upper Vaal	1 229	1 630	1 269	1 632	(42)	50
9 Middle Vaal	55	838	381	503	9	0
10 Lower Vaal	127	571	641	0	57	0
11 Mvoti to Umzimkulu	555	34	1 012	0	(423)	1 018
12 Mzimvubu to Keiskamma	872	0	413	0	459	1 500
13 Upper Orange	4 734	2	1 059	3 589	88	900
14 Lower Orange	(956)	2 082	1 079	54	(7)	150
15 Fish to Tsitsikamma	456	603	988	0	71	85
16 Gouritz	278	0	353	1	(76)	110
17 Olifants/Doring	335	3	370	0	(32)	185
18 Breede	869	1	638	196	36	124
19 Berg	568	194	829	0	(67)	127
Total for country	14 166	0	14 230	170	(234)	5 410

- 1) Based on infrastructure in existence and under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on the assumptions given in paragraph 2.4.2. The assumed growth in urban and rural water requirements results from the anticipated high population growth and current ratios of domestic to public and business water use. Allowance has been made for known developments in urban, industrial and mining sectors only, with no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) More detail for each water management area is given in the corresponding tables in Appendix D.

Table 2.6: Reconciliation of requirements for and availability of water for the year 2025 high scenario (million m³/a)

Component/Water management area	Reliable local yield (1)	Transfers in	Local requirements (2)	Transfers out	Balance (3)	Potential for development (4)
1 Limpopo	295	23	379	0	(61)	8
2 Luvuvhu/ Letaba	405	0	351	13	41	102
3 Crocodile West and Marico	1 084	1 159	1 898	10	335	0
4 Olifants	665	210	1 143	13	(281)	239
5 Inkomati	1 036	0	957	311	(232)	104
6 Usutu to Mhlathuze	1 124	40	812	114	238	110
7 Thukela	776	0	420	506	(150)	598
8 Upper Vaal	1 486	1 630	1 742	2 138	(764)	50
9 Middle Vaal	67	911	415	557	6	0
10 Lower Vaal	127	646	703	0	70	0
11 Mvoti to Umzimkulu	614	34	1 436	0	(788)	1 018
12 Mzimvubu to Keiskamma	886	0	449	0	437	1 500
13 Upper Orange	4 755	2	1 122	3 678	(43)	900
14 Lower Orange	(956)	2 100	1 102	54	(12)	150
15 Fish to Tsitsikamma	452	653	1 053	0	52	85
16 Gouritz	288	0	444	1	(157)	110
17 Olifants/Doring	337	3	380	0	(40)	185
18 Breede	897	1	704	196	(2)	124
19 Berg	602	194	1 304	0	(508)	127
Total for country	14 940	0	16 814	170	(2 044)	5 410

- 1) Based on infrastructure in existence and under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Urban and rural requirements based on high growth in water requirements as a result of population growth and the high impact of economic development. Allowance has been made for known developments in urban, industrial and mining sectors only, with no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) More detail for each water management area is given in the corresponding tables in Appendix D.

While issues of importance have been identified with respect to each of the water management areas, the following areas are of specific note from a national perspective (refer to Appendix D for a more detailed discussion of all the water management areas).

- **Crocodile West and Marico water management area:** Large additional transfers of water to the Pretoria-Johannesburg area in the upper reaches of the Crocodile catchment will be required in future from the Upper Vaal WMA. This will result in growing quantities of return flows becoming available downstream of these centres, and specific attention will need to be given to the optimal balance between the transfer of water and re-use of return flows.
- **Olifants water management area:** Deficits that will result from implementation of the Reserve and the provision of water supplies for future power generation and mining in the Olifants area, and also to support mining in the Limpopo water management area, will have to be addressed. Possible impacts on Mozambique will have to be considered.
- **Inkomati water management area:** Current deficits and impacts associated with implementation of the Reserve will need to be addressed. Joint management with Swaziland of the Komati River will be particularly important, while the impact on Mozambique will also have to be considered.
- **Upper Vaal water management area:** This water management area, which serves as the main source of water for the Gauteng region, should be adequately supplied until close to 2025, given the projections in the base scenario. Future transfers into the area may be required towards the end of the period to provide for growth in the Johannesburg area and neighbouring water management areas. The existing surplus transfer capacity is to be reserved for urban, industrial and mining developments, and not for irrigation.

Despite indications that the Upper Vaal water management area will be adequately supplied with water until about 2025, there is always the possibility that additional water may be required earlier should growth be higher than projected in the base scenario. Because of the impact on the national economy and the long implementation periods associated with large water transfer schemes it is prudent to proceed with the planning process in this regard. The Treaty on the Lesotho Highlands Water Project (LHWP), signed in 1986, provides for further phases to be constructed after Phase 1. However, the present needs for augmentation of the Vaal River System are fundamentally different from those contained in the Treaty, and current projections of future water requirements are dramatically lower than those of the 1980s. Whilst development of Phase 2 (Mashai Dam) of the LHWP remains a possibility, options such as the Thukela Water Project and the transfer of water from the Upper Orange water management area to the Upper Vaal area are also under consideration. A final decision will only be taken after further investigation and due consultation with the co-basin countries.

- **Mvoti to Umzimkulu water management area:** Adequate future water supplies must be ensured for the important Durban-Pietermaritzburg metropolitan area.
- **Berg water management area:** Provision must be made for the future water requirements of the greater Cape Town area. Particular stress may be experienced in this water management area should the high-growth scenario be realised, or should the impact of climate change start to manifest itself in this part of the country, as some scenarios suggest (see section 2.6.2 and Box 2.10).

In general, sufficient water can be made available at all significant urban and industrial growth points in the country for water not to be a limiting factor to economic development. However, given the long lead times for developing new supply schemes, co-operative planning will be required between water users and water management institutions to ensure that water can be made available when it is needed.

2.5.3 Development opportunities

Opportunities for increased water use other than those that arise from urban, industrial and mining growth are also addressed as part of the analysis of the respective water management areas in Appendix D. Opportunities include the following -

- The possible expansion of irrigation in the Upper and Lower Orange and Fish to Tsitsikamma water management areas, utilising water from the Upper Orange water management area.
- The utilisation of surplus water available from the Pongolapoort Dam in the Usutu to Mhlathuze water management area.
- The refurbishment of currently under-productive irrigation schemes and the potential for additional development in the Mzimvubu to Keiskamma water management area.
- Possible forestry development in some catchments in the Usutu to Mhlathuze, Thukela, Mvoti to Umzimkulu and Mzimvubu to Keiskamma water management areas.
- Expansion of irrigation in the north-eastern part of Limpopo Province from the Nandoni Dam in the Luvuvhu River.

2.5.4 Reconciliation interventions

It is important that the strategies adopted are stable over time and can endure even if circumstances change. The strategies and interventions should be able to deal with existing and short term imbalances while conforming to the broad goals of the NWRS, which include the achievement of equity, long-term stability of supply and optimality in the management of water resources. Strategies should also be flexible but stable within the envelope of the high and low scenarios of future water requirements. Adjustments to deal with changed circumstances should mainly be with respect to the timing and sequencing of the different elements of the strategy. The NWRS therefore allows for changes in emphasis and the revision of action plans as growth and developments occur and improved insights are gained. In this way the continued relevance of the Strategy will be assured.

The main interventions by which a balance between the availability of and requirements for water may be achieved are addressed below. The principal considerations in planning reconciliation interventions are briefly described in Box 2.6 and further details of the interventions are given in Chapter 3 under Strategies for Water Resource Management.

- **Demand management**

For many years the tendency has been to resort to constructing additional infrastructure where the demand for water has exceeded the supply. As water use approaches its full potential however, the cost of resource development increases and the environmental impacts become more pronounced. Management of the demand for water is an obvious option for reconciling imbalances between requirements and availability, and has been applied with great success by some users. For example, as is evident from Table 2.4, of the 10 water management areas currently in deficit, 4 would change to a surplus situation if a 10 per cent saving in user requirements could be achieved. Additional perspective with respect to the individual water management areas can be found in Appendix D.

Compared with supply-side management, the management of demand in South Africa is relatively under-developed, although there are world-class examples of water use efficiency in some areas of industry and agriculture that will help to set benchmarks. Some quantitative data is available on water savings resulting from demand management programmes, notably in some of the metropolitan areas and the larger municipalities, but in general insufficient information exists to make reliable estimates of the potential savings in each water management area.

More information will become available as the effects of the Department's water demand management programme become evident (see Part 3 of Chapter 3), and these will be accounted for in the water availability and requirements data in future editions of the NWRS.

In the meantime continuous improvement of and investment in enabling mechanisms, relevant technology and supporting infrastructure for water demand management are priorities in the NWRS.

Box 2.6: Planning interventions to balance supply and demand

In line with the objectives of equitable and sustainable social and economic development, government has progressively adopted a more comprehensive and holistic approach to the planning of interventions to resolve problems of inadequate water availability. This approach accords with the requirements of national policies and legislation relating to the environment, and is informed by internationally accepted best practice.

Whenever there is a water shortage, a range of possible solutions will be investigated, taking account of the availability of surface and groundwater and the interactions between them, and the integration of water quality and water quantity issues. Options will include the following -

- Demand-side measures to increase water availability and improve the efficiency of water use, considered from the start of the planning process in parallel with other solutions (see Part 3 of Chapter 3).
- Re-allocation of water, including the possibility of moving water from lower to higher benefit uses by trading water use authorisations (see Part 2 of Chapter 3).
- The construction of new dams and related infrastructure, including inter-catchment transfers. Where infrastructure construction is indicated as an optimal solution, a range of alternative developments, including the implications of no development, will be presented.

The significant impacts of all development options and other interventions will be assessed and social and environmental considerations will be accorded the same attention as those of a technical, financial and economic nature. The social, environmental and economic impacts of all development options will be evaluated to ensure that the benefits arising from such actions will exceed the costs, that the benefits and costs will be distributed equitably, and that the gender dimensions of the benefits and costs are taken into account. Particular attention will be paid to improving the quality of life of the poor, and ensuring that any negative impacts are minimised or mitigated so that affected communities are not worse off than they were before.

In terms of the Act comprehensive impact assessments may be required to determine the effect of proposed water uses on the water resource, and will be mandatory before a major government water work is constructed. Impact assessments will be undertaken in accordance with the regulations to the Environment Conservation Act, 1989, which are still in force under the National Environmental Management Act, 1998, until replaced by new regulations.

Government recognises the importance of gaining public input to the review of options for managing water resources including infrastructure development and water users, stakeholders and the public will be involved at all key stages of a development project or a scheme. The Department's commitment and general approach to public consultation is discussed in Chapter 4, which also describes the Act's specific requirements for consultation.

Note: The November 2000 World Commission on Dams Report - *Dams and Development: A New Framework for Decision-Making* - is the most recent and most comprehensive approach to decision-making for the development of dams. The Department is currently working with the South African Multi-Stakeholder Initiative on the World Commission on Dams on a systematic review of the Commission's recommendations in the South Africa context. The aim is to build national consensus on the many issues surrounding large water resource developments, and to guide policy and practice. Among other matters the question of ensuring that communities that were negatively impacted by dams in the past have access to the same benefits that arise from new developments is under consideration.

• Water resource management

In its widest sense, water resource management would include all the reconciliation interventions described briefly here and in more detail in Chapter 3. In the context of this discussion, however, it refers to the regulation of stream flow through storage and the control of abstractions and releases for the purpose of providing appropriate quantities of water at

specific times and locations, and of such quality and reliability to meet user requirements. It also includes the conservation of resources through the minimisation of evaporation and effective release management.

Water resources over much of South Africa have been linked through inter-catchment transfers of water and are managed as large integrated systems. In this way water can be transferred from catchments where it is plentiful to where most needed, thereby reducing the potential risks of failure through the combined utilisation of resources over large geographic areas. A high level of sophistication has been reached in this regard, and greater utility is thus obtained from South Africa's water resources than the sum of the component parts. There is nonetheless scope for improving the management of many of the smaller or localised water resource projects, while regular revision of the operating strategies for large water resource systems is required to account for growth and other relevant changes.

- **Managing groundwater resources**

A systematic approach to groundwater was neglected in the past as a result of its "private water" status under the previous legislation, and relatively little was invested in comprehensive resource assessment. Through research and development investment in the past five to ten years it has become clear that groundwater in utilisable, if limited, quantities can be found virtually everywhere, even in the aquifer systems that are classified as "poor". Deep drilling has shown potential for large scale development of groundwater in some areas such as those underlain by the Table Mountain Group geological formations in the south-western Cape. With a focus on the development of local resources groundwater's role in reconciling future demand and supply could rise significantly, and meeting relatively small water requirements from groundwater would be especially attractive.

- **Re-use of water**

In the interior of the country most of the water used in a non-consumptive manner is directly recycled for re-use, or is returned to the rivers after treatment, thereby becoming available for re-use. In urban and industrial areas such as Pretoria and Johannesburg approximately 50 per cent of the total water requirements becomes available as return flow and is re-used. Similar return flows are available in coastal cities such as Cape Town, and the Durban/Pietermaritzburg area, but only about 5 and 15 per cent respectively is re-used in these cities. Should it compare favourably with other options, greater re-use could therefore be a substantial source of water, especially for coastal cities.

Return flows normally have a significant impact on the quality of the receiving waters and this aspect needs to be specially managed. Where return flows are re-used directly, sophisticated treatment processes and proper management may be required, depending on the quality of the return flow and its intended applications.

- **Control of invasive alien vegetation**

Provisional estimates show that annually about 1 400 million m³ of surface runoff, or close to 3 per cent of the national mean annual runoff, is intercepted by invading alien vegetation. If the spread of such vegetation is not controlled, the impact is likely to increase

Through government's inter-departmental Working for Water Programme (see Part 3 of Chapter 3), large areas are being cleared of alien vegetation. The removal and containment of such vegetation should, where applicable, form part of catchment management strategies.

- **Re-allocation of water**

Differential benefits are derived from water use by different user sectors and by users in different parts of the country. Water should ideally be applied to best advantage to achieve the greatest overall benefit for the country from a social, economic and environmental perspective. The re-allocation of water between user sectors is an obvious and powerful option for realising this goal. (Refer also to Box 2.7 on priorities for the allocation of water and Box 2.8 with respect to food security).

To avoid unnecessary disruption, the NWA provides for the gradual re-allocation of water as the need arises in different parts of the country. The main enabling mechanisms are compulsory licensing, supported by water demand management and the trading of water use authorisations (see Parts 2, 3 and 4 of Chapter 3).

Trading in and re-allocation of water can, of course, only be implemented where an adequate water resource and the required infrastructure is available, and provided the impact of water trading is acceptable. It may not be physically possible to trade water use allocations between certain locations. Furthermore, trading between different sectors of water users may impact on the quantity and quality of return flow, and may also result in the water being required at a different assurance of supply, all of which need to be properly accounted for.

- **Development of surface water resources**

From Tables 2.5 and 2.6 it is evident that substantial potential for further development of surface water resources still exists in some parts of the country. Possible resource developments are listed in Tables 3.8.2 and 3.8.3 in Part 8 of Chapter 3.

A factor that reduces the feasibility of new capital-intensive water resource infrastructure developments is the current projection of smaller growth rates than previously used in water requirements in many parts of the country. This would result in longer pay-back periods for the redemption of capital and lead to a reduction in the economic viability of investments. It may reduce the options for new resource development in favour of inducing changes in water use patterns and re-allocation among users.

- **Inter-catchment transfers**

Due to the spatial imbalances in the availability of and requirements for water in the country, as demonstrated by the preceding information and statistics, inter-catchment transfer of water is a necessary reality in South Africa.

From Table 2.4 it can be determined that the transfer of yield between water management areas amounts to over 6 000 million m³/a. Some of these transfers are from upper to lower water management areas through releases along rivers, as in the Vaal and Orange Rivers, while others are effected through inter-catchment water transfers. The quantity of water physically transferred from one catchment to another amounted to about 3 000 million m³/a in year 2000 and it is evident that more water will have to be transferred in future. In comparison, the total surface water yield in the year 2000 amounted to about 11 000 million m³.

Refer to Box 2.5 for an explanation of the difference between the physical transfer of water and transfer of yield. Refer also to Box 2.9 for a summary of the Inter-catchment Transfer Policy, and to Part 4 of Chapter 3 for water use charges relating to transferred water.

Box 2.7: Priorities for allocating water

Water is one of the most fundamental natural resources and it is one of the primary principles of the National Water Act that the nation's water resources are managed in such a manner that their use will achieve optimum long-term social and economic benefits for all people. Water is also a finite resource, and it is recognised that water allocations may have to change over time to meet this objective on an ongoing basis.

The NWA gives highest priority to water for the Reserve, which includes water for basic human needs and for the natural environment. Thereafter international obligations as agreed with neighbouring countries must be respected and honoured.

Beyond this, water should be allocated to ensure that the greatest overall social and economic benefits are achieved. But consideration must not only be given to this primary aim, but also to potential disbenefits to society where water is made available to competing optional uses. This applies both to long-term allocations for water use as well as to short-term curtailments in supply during periods of drought and temporary shortage. Where surplus or unused water exists, prioritisation need not apply, provided that the water is not used wastefully.

To facilitate the most beneficial utilisation of water, a general guide on priorities for water use is given below. The priorities are listed in descending order of importance, although the order may vary under particular circumstances.

- Provision for the Reserve.
- International agreements and obligations.
- Water for social needs, such as poverty eradication, primary domestic needs and uses that will contribute to maintaining social stability and achieving greater racial and gender equity.
- Water for uses that are strategically important to the national economy.
- Water for general economic use, which includes commercial irrigation and forestry. In this category, allocation is best dictated by the economic efficiency of use. With the introduction of water trading, demand will automatically adjust over time to reflect the value of water in particular uses.
- Uses of water not measurable in economic terms. This may include convenience uses and some private water uses for recreational purposes, which are likely to be of low priority.

Additional factors to be considered in assessing priorities for the allocation of water are the level of assurance of supply required, the extent to which to use is consumptive and the quality of return flows.

It is important to realise that all water use by a particular sector or user is unlikely to be of the same priority. Water to maintain primary production functions, for example, would be of higher value and priority than the additional water required for other uses in the same enterprise. This also relates to the efficiency of water use, with greater efficiency leading to a higher value of water. The same principle applies to a greater or lesser extent to all uses of water.

Box 2.8: Water for food security

Food security is often given as a motivation for according high priority to water allocations to irrigated agriculture. One of the primary goals of the NWRS is to facilitate the most beneficial utilisation of South Africa's water resources by all user sectors. However, since irrigated agriculture is by far the largest user sector in the country, it is appropriate to retain a proper perspective on the matter so that there is a common understanding among interest groups of the concepts of food security and food self-sufficiency.

Food security refers to the assurance of having sufficient food available at all times, whilst **food self-sufficiency** refers to the capability for own food production. Both principles can apply to individuals as well as on a national level. The national situation is addressed first.

Although food self-sufficiency can make a major contribution to food security, the ability to produce own food depends on many external factors other than soil, water and climate. In a modern economy, elements such as the availability of machinery and sufficient liquid fuels, and access to technology, finance and management skills may also be prominent in determining the ability of a country to produce sufficient food to meet all its requirements, thereby achieving food security through self-sufficiency. A strong, diversified and globally well-integrated economy with a high level of employment may better provide for national food security than to strive for self-sufficiency. Hong Kong and Singapore are successful examples in this respect.

South Africa is currently self-sufficient with respect to most of its food requirements, the bulk of which is produced by rain-fed agriculture. Whilst irrigated agriculture also makes a major contribution to the national food basket, particularly vegetable production, a large proportion of commercial production under irrigation is for export (such as sugar, citrus, deciduous fruits and table grapes), and of non-food products (such as wine and tobacco). In this respect, commercial irrigation contributes to food security through trade links, foreign earnings and employment creation, similar to many other sectors of the economy, but does not directly provide for food self-sufficiency.

Since most crops grown under commercial irrigation represent economic use of water, such irrigation should be subject to the same allocation criteria as other economic uses, taking all forward and backward linkages into consideration, where preference is to be given to uses that achieve the greatest overall benefits for the nation. In certain cases it may be to South Africa's advantage to import more food or other products if the water and other resources consumed for the its production in South Africa could be applied to other products that would create greater wealth and welfare and where the balance of impacts would be favourable.

Different considerations apply to irrigation for meeting the basic needs of people, such as subsistence irrigation and small scale irrigation for communal gardens. There are many unemployed and impoverished people in South Africa, especially in the rural areas, who do not have the financial means to purchase food and whose only solution to food security is through achieving household food self-sufficiency. After meeting the requirements of the Reserve and honouring international agreements and obligations, the NWRS therefore affords high priority to water for poverty eradication and related social needs. This may include water for own food production and the creation of micro-enterprises. Relatively small volumes of water can, if managed optimally, support the production of sufficient food to meaningfully improve the livelihood of people living in extreme poverty.

The Department is also aware of the importance of maintaining a vibrant and sustainable rural economy, and of maintaining a proper balance from a national socio-economic perspective between the rural and urban economies and populations. It is not the role of the Department to engineer this however, but rather to work together in consultation with other departments to support the achievement of government's policy objectives.

Box 2.9: Inter-catchment transfer of water

The National Water Act recognises both the relative scarcity of water in South Africa and the uneven and often unfavourable distribution of water resources in both space and time. The national government is therefore entrusted with the responsibility to effect the equitable allocation of water for beneficial use and to ensure that sufficient water is available to support the continued growth and wellbeing of the country. This includes the preparation of guidelines for the spatial redistribution of water as well as the actual implementation of inter-catchment transfer projects, where applicable.

An inherent benefit of linking the country's water resources over a large geographic area is that it can, in certain circumstances, help to manage the consequences of climatic variability through the transfer of water supplies to areas that may be suffering from severe drought conditions, from areas where the prevailing conditions are less critical. This not only helps to prevent disasters, but also provides the opportunity of operating the available resources in a systems context, thereby achieving an overall yield that is greater than the sum of the component parts.

The same technical, environmental, social and economic considerations as are applicable to any water resource development and use of water are applicable to inter-catchment transfers of water. Key considerations and items of specific relevance to inter-catchment transfers can be summarised as follows -

- Priorities for water use are stipulated in the NWA and are also contained in the NWRS. The highest priority in a catchment is to be afforded to the provision of water for the Reserve and to honoring international rights and obligations. Thereafter, consideration is to be given to the most beneficial use of water (actual and potential), both within the source and the (potential) recipient basins.
- The allocation of water away from a catchment can only be justified if it results in an overall benefit from a national perspective. Any negative impacts, or the loss of opportunity as a result of the transfer, must be outweighed by the advantages that are created. Full consideration must be given to any possible negative impacts in the source basin and all reasonable measures must be taken to mitigate such impacts in the interest of those affected.
- The maintenance of environmental integrity is of particular importance in all water resource developments. The inter-catchment transfer of water may have unique impacts on natural ecosystems that extend beyond those associated with in-catchment developments, and these need to be considered and provided for. In addition to comprehensive environmental impact assessments being undertaken in both the source and receiving areas, specific consideration must be given to the possible transfer of organisms and changes in habitat conditions.
- Interbasin transfers will only be permitted subject to water conservation and demand management by the relevant authorities and user organisations in the receiving region conforming to the applicable criteria in this regard. Similarly, inefficient or non-beneficial use of water in a source basin cannot serve as reason for not transferring water.
- The transfer of water for the express purpose of meeting the requirements of the ecological component of the Reserve in the receiving catchment will not be considered.
- Water should not be reserved over unduly long periods of time for possible future use within or outside a catchment, in this way foregoing opportunities for the interim beneficial use of such water. Where appropriate, water use licences of short duration may be issued.
- In determining the volumes of water to be transferred from one catchment to another, water that is not already gainfully utilised and water resource potential still to be developed will be considered first. The re-allocation and inter-sectoral redistribution of water from existing to more beneficial uses should only be effected where merit can be clearly demonstrated on an economic and social basis.
- Conforming to the principle in the NWA that water is a national resource that belongs to all people, no payment is to be made to a source catchment for the actual water transferred. A portion of the water resource management charge raised in the recipient catchment will, however, revert to the source catchment and opportunities will be sought to mitigate any negative impact that may result.
- All costs associated with the transfer of water will be borne by the users of the transferred water. These include normal water use charges in terms of the prevailing pricing policy together with project and operational costs, as well as the cost of possible mitigation measures.
- The national government will normally initiate, plan and authorise inter-water management area transfers.

- **Water quality considerations**

Although not a reconciliation intervention in itself, water quality is a fundamental element of water resource management and is a primary consideration in all the options for the reconciliation of water requirements and availability. In addition to making sufficient quantities of water available for use at specific locations and times as required, it is essential that water also be of appropriate quality for the intended use, whether it be for abstraction or for the purposes of the ecological Reserve. All the intervention options will impact on water quality in some way. These impacts may manifest themselves in the quality of water delivered to the user, the treatment or blending requirements to render the water fit for the purpose intended, the quality of return flows, and the assimilative capacity of and resultant water quality in streams and other water bodies from which water is abstracted or into which it is discharged. The regulation of water resources by dams may also assist in managing water quality as a result of the mixing and balancing effects of storage, as well as impacting on it by, for instance, increasing salinity levels due to evaporation from the water surface of reservoirs. Where problems are encountered as a result of excessively high salinity levels the blending of waters of different quality, as well as desalination, may have to be resorted to.

It is necessary for the chemical, biological and physical characteristics of water to be addressed when the water resource management options and other interventions are considered. Also refer to Protection of Water Resources in Part 1 of Chapter 3.

- **Environmental considerations**

Similar to water quality, environmental considerations are also integral to all reconciliation interventions. The impacts on both the social and natural environment need to be taken into account, and assessed together with the technical, economic and other factors.

Social impacts broadly refer to how people's lives and livelihoods may be affected, and relate to social networks and ways of life, economic activities, and gender, cultural and religious issues. Developments that may be to the benefit of some people could however have negative impacts on others. Inundation of land by storage reservoirs for example, may impact on access routes, fragment and separate communities, necessitate the relocation of people, render former productive land inaccessible, cause inundation of historical and archaeological sites; whilst the positive impacts of the new storage are likely to result from the additional water that can be made available to users, less frequent curtailments in supply, and the creation of recreation opportunities.

All water resource developments also impact on the functioning of aquatic ecosystems, typically by changing habitat conditions as a result of changed flow and water quality regimes.

All interventions to reconcile the requirements for and availability of water are thus likely to have some impacts, which need to be identified and evaluated together with other relevant factors to enable an informed decision to be reached.

Varying combinations of the above intervention options will be employed depending on their suitability in each water management area or sub-area. Interventions may also be guided by considerations related to the quality of water.

It is essential that the growth in water requirements together with the main factors influencing water requirements and availability be monitored and regularly be re-assessed, and that appropriate adjustments to management strategies be made. A minimum requirement in this respect is the five-yearly review of the NWRS as specified in the National Water Act.

2.6 OTHER FACTORS INFLUENCING WATER AVAILABILITY AND WATER REQUIREMENTS

Both the availability of water and the requirements for water are subject to complex interrelationships and external influences, which are beyond the scope of the NWRS to address in detail. Population is generally accepted as one of the main drivers of water demand, as discussed in Section 2.4.2. However, water requirements for basic human needs are relatively small, representing less than 5 per cent of the current national requirements for water, or about 1 per cent of the mean annual runoff. The main stimulants for increased water demand are economic activity and standard of living, the latter in itself being closely related to economic activity. Recognition of this relationship provides a useful guide for the management of water.

Two key influencing factors with respect to resource availability not specifically addressed previously - land use and climate change - are described below.

2.6.1 Land use

The Act recognises the potential influence of land use practices on the proportion of rainfall that reaches streams or penetrates to groundwater. Currently, afforestation is the only stream flow reduction activity that is subject to authorisation as a water use, although other land-based activities are being investigated. Other factors that may influence water availability and that were accounted for in the NWRS database are invasive alien vegetation, some rain-fed cultivation of crops and impervious surfaces in urban areas. It is important that consideration be given in relevant catchment management strategies to the protection of mountain catchment areas from which large quantities of runoff originate.

In some parts of the country, overgrazing and denudation has significantly increased the quantities of sediment that reach the rivers, leading to a loss of reservoir storage and significant changes in the morphology of some rivers. It has been estimated that the costs associated with the combined downstream losses from sediment are an order of magnitude greater than the national investment in soil conservation. The management of land must therefore become a focus for co-operation among the government departments responsible for administering land use.

2.6.2 Climate Change

Climate change has the potential to impact very significantly on both the availability of and requirements for water in South Africa.

There is evidence that global temperatures are rising. Some climate models suggest that this could increase the variability of climate and decrease rainfall in South Africa. According to these models stream flow could decrease, possibly by as much as 10 per cent by 2015 in the most affected parts of the Western Cape. The models suggest that the reduction in runoff will progress from the west to the east coast by about 2060. The effect on groundwater recharge is less predictable, but could even be greater. An increase in the variability of stream flow would mean that, even if the average rainfall were to remain the same, natural yields and reliability would be reduced and the unit cost of water from dams would increase. The water requirements of plants, and therefore irrigation requirements, would also increase should warmer climatic conditions manifest themselves. A decrease in water availability will also impact on water quality, thereby further limiting the extent to which water may be used and developed. (See Box 2.10 for more detail.)

Whilst phenomena have been observed internationally that point to the likelihood of changing climatic patterns, there is as yet little conclusive evidence of any accelerated large scale and persistent long-term climatic shifts in South Africa. It is prudent, however, to anticipate the possibility of climate change and to take this into consideration in the development of catchment management strategies. A balance will have to be sought between preparedness and overreaction, to prevent valuable resources being wasted. The situation is therefore being

monitored, with special attention given to monitoring selected, relatively unimpacted benchmark catchments; and needs to be formally re-assessed with each five-yearly review of the National Water Resource Strategy over the long term (also refer to Part 6 of Chapter 3). The implications of climate change are addressed in more detail in the water management area reports, particularly for those geographic areas that are could experience the greatest impact.

Box 2.10: Climate change

Scientific observations have shown that the average air temperature of the earth has increased by between 0.3°C and 0.6°C during the past 100 years. About two-thirds of this increase has occurred over the past 40 years and there is strong evidence that much of the warming can be attributed to human activities^[1].

Although climate change is expected to affect many sectors of the natural and built environments, water is considered to be the most critical. South Africa, because of its general aridity and high variability of rainfall in space and time, is especially vulnerable to changes in water availability, with its implications for social and economic development.

A study^[2] has recently been carried out to assess the potential effects of global climate change in South Africa, Lesotho and Swaziland, and to identify the sectors and areas of high vulnerability to climate change and propose adaptation measures to offset adverse consequences. In the study, four global circulation models (GCMs) were used to estimate possible changes in temperature and precipitation. This was followed by application of a suitably modified Agricultural Catchments Research Unit (ACRU) model to estimate the potential impacts on hydrological response in terms of stream flow and recharge into the unsaturated soil above the groundwater table (the vadose zone).

There was general agreement among the GCMs with regard to climate projections. In all cases an extension of summer season characteristics was indicated, with continental warming of between 1°C and 3°C, the maximum focusing on arid regions and the minimum occurring along coastal regions. There was less agreement with regard to precipitation, but in general terms reductions of the order of 5 to 10 per cent of current rainfall were suggested. Estimates made using the GCMs to generate local-scale climate data indicated the likelihood of an increase in the duration of the dry-spell in the interior and north-eastern areas of the country, followed by more intense convective rainfall events and the possibility of more frequent and severe flood events. The probable net effect would be greater evapo-transpiration and more stress on arid and marginal zones.

Hydrological responses were assessed using one of the hotter, drier GCM scenarios. Runoff was found to be highly sensitive to changes in precipitation, since a relatively small fraction of rainfall is converted to runoff. Groundwater recharge was found to be even more sensitive. The conclusion from the study was that, under the hot and dry scenario, South Africa could realistically expect to experience a decrease in runoff of up to 10 per cent in some areas. A related "threshold" study indicated that a runoff reduction of this magnitude could manifest in the western parts of the country by 2015. The decrease in runoff would move progressively from west to east and could be expected to reach the east coast by 2060. Recharge into groundwater displayed a more patchy and less systematic pattern.

It must be emphasised that these conclusions are not predictions or forecasts. They are at best projections of how the global climate system may possibly evolve in the future, and how such changes may affect climate on a local scale. Water resources planners will use the projections to create scenarios of future water availability, but there must be interaction between all water-dependent sectors to ensure that all available measures are considered to adapt to changing circumstances and reduce vulnerability. Nevertheless, it is important that no development or investment decisions are made that neglect to take into account the actual or potential affects of climate change on water resources.

1. Global warming is widely attributed to the release into the atmosphere of greenhouse gases, which are defined by the Kyoto Protocol as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydroflourocarbons (HFCs), perflourocabons (PFCs) and sulphur hexaflouride (SF₆).
2. South African Country Study on Climate Change: Vulnerability and Adaptation Assessment Study, 2000 (in press).

2.7 WATER RESOURCES UNDER THE DIRECT CONTROL OF THE MINISTER

A proportion of the available water, in respect of both quantity and quality, in each water management area is under the direct control of the Minister in terms of his or her national responsibilities. This includes the Reserve, water to meet international obligations, a possible provision to meet realistic future requirements, transfers between water management areas and water uses of strategic importance. The water that is to be reserved for specific purposes in each of the water management areas is discussed in Appendix D.

2.7.1 The Reserve

The highest priority is afforded to provision of water for the purposes of the Reserve. The first objective is to ensure that sufficient quantities of water of appropriate quality are reliably available to provide for basic human needs. In terms of current policy, a quantity of 25 litres per person per day has been incorporated for this purpose under the urban and rural requirements in Table 2.3. Should this quantity be increased in future, the Reserve will be re-determined.

The second priority is the provision of water for safeguarding and sustaining healthy ecosystems, including fauna and flora. Owing to the complex interdependence amongst species in nature, and our extremely limited knowledge of the wide spectrum of habitat and water requirements, only provisional estimates of the ecological water requirements are presented in this edition of the NWRS. Although based on a countrywide assessment of the conservation status of rivers and estuaries, and the scientific estimation of water requirements, much further work is still required. A programme for the improved determination of the Reserve has therefore been initiated and refinements to the Reserve will continue to be made in future editions of the NWRS.

2.7.2 Water required for international rights and obligations

South Africa is committed to the joint management and equitable utilisation of the international waters that it shares with neighbouring countries, as negotiated from time to time through relevant bi-national and multi-lateral forums. South Africa will not implement water resource developments that may have negative impacts on a co-basin country or countries without prior consultation with those countries. This is described in the Revised Protocol on Shared Watercourses in the Southern African Development Community, discussed in Chapter 5.

Where agreements exist on specific quantities of water to be available to a particular country, these are addressed under the respective water management areas in Appendix D. It is anticipated that agreements will also be reached in respect of water quality issues in rivers flowing from one country into another.

2.7.3 Water use of strategic importance

Analogous to the importance of water as a primary life-sustaining resource, electricity is fundamental to the functioning of modern society. It is also a high-value economic use of water. Much of the country's economic activity, as well as its social stability, depend on a sufficient and reliable supply of electrical power. The abstraction and storing of water for use at power station operated by Eskom, as the organisation entrusted with generating the bulk of the country's electricity, is therefore regarded as being water use of strategic importance. All water that is taken from a water resource or stored for whatever purpose at Eskom power generation facilities will therefore be authorised by the Minister (see Part 3 of Chapter 3). Water use designated as being of strategic importance will, however, be subject to the same efficiency criteria and water demand management requirements as is applied to other uses. Dry-cooling of power stations should be applied where feasible when new generating capacity is built.

2.7.4 Contingency to meet projected future growth

Projections of the future requirements for water are given in Tables 2.5 and 2.6 for each of the water management areas, together with an indication of the resource potential that could still be

developed. The best strategies for the future reconciliation of requirements and availability will be combinations of various possible interventions as referred to in Section 2.5.4. Only under certain conditions will further resource developments and transfers of water prove to be desirable.

It is therefore not generally practical for reservations to be made of specific quantities of water to allow for future growth. However, there are certain instances where the limited resources still available must be reserved. In this respect, clear statements are made in Appendix D with regard to each of the water management areas where –

- known quantities of water need to be reserved for specific uses or transfer;
- general reservations that are not quantifiable at present need to be made for future priority uses; and
- dam sites need to be reserved for specific purposes.

This will ensure that optimal development choices are not forgone and developments are not allowed in one area that will unwittingly prejudice another. These reservations will be reviewed as part of the formal process of revision of the NWRS.

2.7.5 Reservations for transfer between water management areas.

Allocations reserved for transfer between water management areas are also regarded as water use of strategic importance, and are established by the Minister in the NWRS. The relevant quantities are given in the respective water management area reports in Appendix D.

Notes to Chapter 2

¹ Since the information on water availability and water requirements presented in the tables in this Chapter and in Appendix D appendix was derived small changes have been made the boundaries of the some of the water management areas - see Part 5 of Chapter 5 and Appendix E. These changes have insignificant impact on the statistics presented, and any discrepancies will be corrected at the first revision of the NWRS.

² Section 23 - Determination of quantity of water which may be allocated by responsible authorities (see Part 5 of Chapter 3 for a definition of a responsible authority):- (1) Subject to the national water resource strategy the Minister may determine the quantity of water in respect of which a responsible authority may issue a general authorisation and a licence from water resources in its water management area. (2) Until a national water resource strategy has been established, the Minister may make a preliminary determination of the quantity of water in respect of which a responsible authority may issue a general authorisation and licence. (3) A preliminary determination must be replaced by a determination under subsection (1) once the national water resource strategy has been established. (4) A responsible authority must comply with any determination made under subsection (1) or (2). (5) In making a determination under subsections (1) and (2) the Minister must take account of the water available in the resource.

³ Section 1(1)(xviii) of the NWA defines the Reserve as follows: The quantity and quality of water required – (a) to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No. 108 of 1997), for people who are now or who will, in the reasonably near future, be (i) relying upon; (ii) taking water from; or (iii) being supplied from the relevant water resource; and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource. The Reserve is therefore one of the important links between the National Water Act and the Water Services Act.

⁴ The ecological component of the Reserve is determined for "average" hydrological conditions and also for drought conditions.

⁵ The demographic database was compiled prior to the results of the 1996 National Census being available. The database was subsequently adapted to reconcile it with the National Census results by making changes in areas where the census appeared to provide superior information. The 2001 National Census results were not presented in terms of urban and rural populations, but gave a total population of 44.82 million. Projections made by Statistics SA from the 2001 National Census (a total population mid-year 2003 of 46.43 million) and by the Department from the 1996 National Census (a total population in

April 2005 of 48.43 million - urban 26 million, rural 22.43 million) indicate that the projections from the demographic database are realistic for the first ten year period.

- ⁶ Government is committed to eliminating the backlog on basic water services and to progressively improving levels of service over time - see references to the Water Ladder in the Strategic Framework for Water Services, discussed in Note 6 to Chapter 1.

CHAPTER 3 - STRATEGIES FOR WATER RESOURCES MANAGEMENT

This chapter describes the strategies, objectives, plans, guidelines and procedures, and the institutional arrangements necessary for the protection, use, development, conservation, management and control of South Africa's water resources.

The chapter is divided into nine parts as follows -

- Part 1 : Protection of Water Resources
 - Part 2 : Water Use
 - Part 3 : Water Conservation and Water Demand Management
 - Part 4 : Water Pricing and Financial Assistance
 - Part 5 : Water Management Institutions
 - Part 6 : Monitoring and Information Systems
 - Part 7 : Disaster Management
 - Part 8 : Anticipated Programme of Implementation Activities
 - Part 9 : Financial Implications
-

CHAPTER 3

PART 1 – PROTECTION OF WATER RESOURCES

(Provisions relating to the protection of water resources are found in Chapter 3 of the National Water Act)

3.1.1 INTRODUCTION

It was noted in Chapter 1 that the fundamental objectives for managing South Africa's water resources are to achieve equitable access to water resources and their sustainable and efficient use. In Chapter 2 it was concluded that, although they are limited and highly variable, the country's water resources will be sufficient to support social and economic development for the foreseeable future provided they are judiciously managed, and wisely allocated and utilised.

Equitable access has both a short-term and long-term dimension. It is important that the needs of current and future generations are considered in the management of water resources.

To give effect to the interrelated objectives of sustainability and equity an approach to managing water resources has been adopted that introduces measures to protect water resources by setting objectives for the desired condition of resources, and putting measures in place to control water use to limit impacts to acceptable levels.

The approach comprises two complementary strategies as follows -

- **Resource-Directed Measures:** These measures focus on the quality of the water resource itself. Resource quality reflects the overall health or condition of the water resource, and is a measure of its ecological status. Resource quality includes water quantity and water quality, the character and condition of in-stream and riparian habitats, and the characteristics, condition and distribution of the aquatic biota. Resource quality objectives will be defined for each significant resource to describe its quality at the desired level of protection. (See Note 3 in Chapter 1 and Part 2 of this chapter for the definition of water use).
- **Source-Directed Controls:** These measures contribute to defining the limits and constraints that must be imposed on the use of water resources to achieve the desired level of protection. They are primarily designed to control water use activities at the source of impact, through tools such as standards and the situation-specific conditions that are included in water use authorisations. Source-directed controls are the essential link between the protection of water resources and the regulation of their use. (Conditions of use are discussed in Part 2 of this chapter).

Coherent and integrated approaches to balancing the protection and use of water resources will therefore require the collective application of resource-directed measures and source-directed controls in respect of water quantity and quality, as well as the biological and physical dimensions of the resource.

Although the Act promotes, among other things, resource protection to support long-term sustainable use and development, water resources are sometimes polluted or damaged through accident, negligence or deliberate actions. In such cases the Act holds the parties responsible for the pollution or damage liable for any clean-up or rehabilitation that may be necessary.

3.1.2 RESOURCE-DIRECTED MEASURES

The system for classifying water resources, the process to determine a class for each significant water resource, and the process to determine the Reserve and resource quality objectives for the resource in accordance with its class are still under development.

*These measures will **not** be established via the National Water Resource Strategy (NWRS), because the Act requires the following -*

- The classification system for water resources is to be established (prescribed) in terms of section 12 of the Act by means of regulations after mandatory public consultation and consideration by Parliament^[1].*
- The determination of the class, the Reserve and resource quality objectives for a water resource are to be established by Government Notices in terms of sections 13 and 16 of the Act respectively, following mandatory public consultation.*

It is anticipated that the Department will invite comments on these proposals, in accordance with the Act's requirements for consultation, by the end of 2004.

Information on possible approaches to resource protection is provided in the NWRS to present as complete an account as possible of the Department's intentions for water resources management.

An important consideration in the development of resource-directed measures is that they should be technically sound, scientifically credible, practical and affordable.

3.1.2.1 A national water resources classification system

A water resource classification system is being developed that will provide a consistent framework within which water resources can be classified, each class representing a different level of protection. The desired level of protection will be considered to have been achieved if the conditions appropriate to the designated class are achieved. The system will provide specifications against which management decisions can be made about the nature and extent of permissible, sustainable resource use. Increasing restrictions on use will apply as the level of protection increases. Water users and stakeholders will be involved during the development of the classification system, and the system will also provide guidance on the involvement of water users and other stakeholders in the process of classifying water resources.

The classification of water resources is designed to protect aquatic ecosystems, as well as terrestrial ecosystems that are dependent on groundwater, in order to ensure sustainable utilisation and protection of the resources. The classification of water resources will therefore assist in achieving a balance between the long-term ecological health and integrity of all water resources and the continuing availability of water for social development and economic activities.

Three management classes are being considered, representing three conditions of use as described below.

Natural

A resource classified as Natural will be one in which –

- human activity has caused no or minimal changes to the historically natural structure and functioning of biological communities (animals and plants), hydrological characteristics and the bed, banks and channel of the resource; and
- chemical concentrations are not significantly different from background concentration levels or ranges for naturally occurring substances.

An approach being considered is that, for a resource to be classified as Natural, one of the following criteria should apply -

- The resource is situated in a national or international heritage site or wilderness area;
- It has compelling biodiversity characteristics;
- It is a protected site under the Ramsar Wetlands Convention;
- It is situated in an area that has economic importance for tourism or the harvesting of medicinal plants;
- It has social and/or cultural significance; or
- It is an area designated as Natural under other legislation.

The Natural class will provide a reference condition for other resources classified at greater levels of impact, that is, resources in other classes will be defined in terms of the degree of deviation from the Natural class.

Moderately used / impacted

This class represents resource conditions that are slightly to moderately altered from the Natural class reference conditions due to the impacts of human activity and water use.

Heavily used / impacted

This class represents resource conditions that are significantly changed from the Natural class reference conditions due to the impacts of human activity and water use, but that are nonetheless ecologically sustainable.

Water resources will normally be managed in order to achieve the long-term goals of the management class. When there are pressing social and economic reasons to permit uses that will cause limited, short-term and reversible degradation of the resource, these cases will be considered on their merits, within the framework of resource protection for long-term sustainability.

Unacceptably degraded resources

As a result of over-exploitation or major alteration to their physical structure, some resources are already in a condition that can be described as unacceptably ecologically degraded. In these cases the management class will be set as a minimum of heavily used / impacted and management will aim to rehabilitate the resource at least to this status.

Specific provisions may be developed to accommodate permanently modified rivers (such as some urban rivers) in the classification system in order to ensure appropriate conditions for the management of these resources to achieve an acceptable state.

In some cases the present levels of resource use (existing lawful use) may fail to comply with the resource quality objectives. These situations will need to be addressed progressively, over realistic periods of time, to allow users to adjust their activities, by attaching appropriate conditions of use to licences. Regular monitoring will be required to assess changes in the condition of the resource, and to determine the extent to which resource quality objectives are being achieved. (Part 6 of this chapter provides details of the monitoring and information systems that will be required). Successful resource rehabilitation will therefore require the application of source-directed controls, embodied in licences as conditions of use, that are guided by the resource quality objectives derived from the determination of resource-directed measures. Physical rehabilitation such as restoration of physical structure and removal of alien vegetation may also be required.

The classification system will apply to all surface water resources in South Africa, but will provide for the different characteristics of rivers, wetlands, impoundments and estuaries. The

classification system for groundwater will be generically similar to that for surface water but, because of the nature of groundwater, it will have its own unique features (see 3.1.4 following).

The quantitative and/or descriptive characteristics that will be used to classify surface water resources may include chemical and physico-chemical, biological and hydro-geomorphological attributes^[2]. Social and economic considerations will be included in the classification process to ensure a decision that provides a balance between protection and utilisation.

Each management class will allow for a range of values for each parameter as well as for different resource types. The boundaries between classes will be determined in the classification system and represent points selected along a continuum of change.

For certain resources, water use requirements (for agriculture, for instance) may require stricter standards than those required for ecological protection, and these standards will be captured in the resource quality objectives for that water resource.

3.1.2.2 Biodiversity conservation

It is not possible for all resources throughout the country to be given a high level of protection without prejudicing social and economic development. Equally it is not desirable for all resources to be classified at a uniformly low level so as to permit maximum use. An *ad hoc* approach to resource protection would not address the variability among living organisms and their habitats required to represent all aspects of biological diversity. Accordingly a systematic and strategic approach is being developed to ensure that biodiversity conservation - required to conserve representative diversity and ecological functioning of South Africa's water resources - is achieved.

3.1.2.3 Classification of water resources, determination of the Reserve and resource quality objectives

The class of a resource, the Reserve and its resource quality objectives are intimately related to one another.

- The Reserve (see Note 1 in Chapter 2) includes the quantity and quality of water to meet basic human needs and to protect aquatic ecosystems.
- Resource quality objectives provide numerical and/or descriptive statements about the biological, chemical and physical attributes that characterise a resource for the level of protection defined by its class. Thus resource quality objectives might describe, among other things, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat, and the characteristics and condition of the aquatic biota.
- Resource quality objectives must take account of user requirements and the class of the resource.

Accordingly, the determination of the management class of a resource and the related Reserve and resource quality objectives (jointly, a *resource-directed measures determination*) will usually be undertaken as an integrated exercise. This will be done once the resource classification system is established. At present, until the classification system is established, all determinations are "preliminary" in terms of the Act (see Box 3.1.1).

Because water use authorisations may be considered before the class and the Reserve have been determined for the resource in question (see Box 3.1.1 and Part 2 of this chapter), the appropriate procedures will be applied on an *ad hoc* basis when required for individual and *ad hoc* applications for water use.

Resource-directed measures may be determined for a localised area or for a larger area such as a whole catchment area. In a larger area, resource units that require individual attention will be identified on the basis of different biophysical characteristics.

Box 3.1.1: Determinations and preliminary determinations

The Act speaks of *determinations* of class and resource quality objectives (section 13(1)), and of the Reserve (section 16(1)), as well as of *preliminary* determinations (sections 14(1) and 17(1) respectively).

"Preliminary" in this context refers to a determination carried out before the formal prescription of the classification system. This is a transitional measure that makes it possible to license water use while the classification system is being developed and established in terms of the Act.

Preliminary does not refer to the method used for the determination, the resolution of the determination or to the level of confidence in the results. A preliminary determination may be carried out using any method and at any resolution.

Authorisation of water use is however always subject to the preliminary determination, and considering the requirements of the Reserve.

The Act does not require a process of public consultation for preliminary determinations, nor does it require them to be published. In practice, however, in the interests of openness and transparency, the Department will as far as possible consult with the public in respect of major preliminary determinations.

3.1.3 SOURCE-DIRECTED CONTROLS

Source-directed controls were implemented to a limited extent under the 1956 Water Act, notably in respect of the waste discharge permit system. Source-directed controls are now incorporated into conditions in water use licences and general authorisations. The conditions that may be imposed on water use are described in section 29 of the Act, and cover all aspects of all types of water use. They are closely associated with the resource quality objectives discussed previously, and are intended to ensure that the cumulative impact of water use, in respect of quantity and quality, does not exceed the limits appropriate to the class of the resource.

Source-directed controls for all water use will continue to be implemented as licences are issued, and will contribute to the achievement of the objectives for the protection and use of a resource in terms of its class. Source-directed controls will also inform the drafting of regulations on water use under section 26 of the Act. Licence conditions and regulations on water use are discussed in Part 2 of this chapter.

Source directed controls may be categorised as follows -

- Best management practice measures that relate to measures and standards that apply nationally with respect to water use.
- Special measures relate to source-related requirements dictated by and/or derived from catchment management strategies and/or plans.
- Site specific measures relate to measures arising from the process of authorising water use. They take account, among other considerations, of general authorisations specified at national or regional levels, and considerations that are specific to the water use being considered in a particular location.

3.1.4 PROTECTION OF GROUNDWATER RESOURCES

Groundwater resources differ from surface water resources in that they are not confined to distinct, visible channels, move very slowly and are less prone to rapid temporal variations than surface water. Without proper monitoring and management human impacts are usually difficult to detect. As the rehabilitation of polluted or impacted aquifers is technically very difficult, lengthy and costly, a careful approach to groundwater protection is required. Because of the technical differences between surface and groundwater, groundwater management has to be

considered in its own right, although an integrated approach is required if effective water resource management is to be achieved.

Resource-directed measures will continue to play an important role in the management of groundwater resources, specifically to ensure that groundwater use is sustainable. The protection of groundwater quality will, however, mainly be achieved by source-directed controls focusing on land-based activities that impact underlying groundwater bodies. Examples of this include the siting and construction of waste disposal sites and sewage treatment plants. The widespread, but usually highly localised occurrence and use of groundwater makes it economically impossible to protect all sources to the same degree. Effective and focused protection interventions will be facilitated by a differentiated approach, based on a system of resource classification designed specifically for groundwater resources.

3.1.4.1 Classification of groundwater resources

Like surface water resources, all significant groundwater resources in South Africa will, over time, be classified using similar criteria and approaches.

3.1.4.2 The groundwater Reserve

Because of the contribution of groundwater to surface water flow in certain circumstances, the volume of groundwater that can be abstracted without impacting the ability of groundwater to sustain or contribute to the surface water Reserve has to be determined. This is done by determining recharge to a particular groundwater resource, assessing the groundwater contribution to (base) flow of a surface water resource and calculating the basic human needs to be met from groundwater supplies. It is also necessary to control the amount of water abstracted to protect the structural integrity of the aquifer and to protect terrestrial ecosystems dependant on groundwater supplies.

3.1.4.3 Resource quality objectives for groundwater resources

Resource quality objectives for groundwater resources are considered crucial for the effective protection of groundwater. Numeric or descriptive statements for a groundwater resource will be set in order to guide the use and management thereof. Typically these will relate to –

- groundwater levels or gradients (time and locality specific);
- groundwater abstraction rates;
- groundwater quality;
- spring flow; and
- targets for the health of terrestrial ecosystems that are dependent on groundwater.

Resource quality objectives will inform licence conditions for use of a particular groundwater resource.

3.1.5 WETLANDS

Wetlands are important features of water resource systems. If they are sufficiently protected they offer multiple benefits including a range of services such as flood attenuation, groundwater recharge and sediment control, and act as natural filters by trapping pollutants. However, They also “use” significant quantities of water through evaporation. They are biologically productive, and can be also important centres of biodiversity. Wetlands offer a range of resources for human use, such as reeds and grasses. Many wetlands have however been completely destroyed or severely damaged, most often by draining to provide additional croplands. Some wetlands are registered protected areas, including World Natural Heritage and Ramsar sites. The protection of wetlands will be effected by the strategies and procedures prescribed for resource directed measures, and in conjunction with the national and provincial departments of environmental affairs which have a key role in the protection of biodiversity.

Notes to Chapter 3, Part 1

¹ All regulations must be the subject of public consultation (section 70 of the Act) and must also be considered by the National Assembly and the National Council of Provinces (section 71).

² Chemical and physico-chemical characteristics include salt concentration, pH (a measure of acidity), nutrient concentrations, dissolved oxygen, temperature and toxic substances.

Biological characteristics include the composition and abundance of aquatic flora (plants) and benthic invertebrate fauna (bottom-dwelling animals), and the composition, abundance and age structure of fish.

Hydro-geomorphological characteristics include the hydrological regime (quantity and dynamics of water flow), connection to groundwater, variations in water depths and widths, the structure and substrate of the river channel, and the structure of the riparian zone.

CHAPTER 3

PART 2 – WATER USE

(Provisions relating to the use of water are found in Chapter 4 of the National Water Act)

3.2.1 INTRODUCTION

Chapter 4 is one of the most important parts of the National Water Act, 1998 (the Act) because, among other things, it describes the provisions according to which water use may be progressively adjusted to achieve the Act's principal objectives of equity of access to water and sustainable and efficient use of water.

Concerning equity of access, the Act replaces the previous system of water rights and entitlements, many of which were based on the ownership of riparian land (see Chapter 1, Note 8), with a system of administrative, limited-period and conditional authorisations to use water. These are granted to users either directly in terms of Schedule 1 of the Act, or by a responsible authority (defined in Part 5 of this chapter).

Many of the Act's sustainability- and efficiency-related measures will be applied by means of conditions of use imposed when water use authorisations are granted. Conditions of use give formal expression to the source-directed controls discussed in Part 1 of this chapter, which are themselves derived from the resource-directed measures for resource protection. Conditions of use balance the need to protect water resources with the need to use water for social and economic development.

Formal water use authorisations will also facilitate the administrative control of water use by water management institutions and form the basis upon which charges for water use may be made. They also provide for the collection of water-related data and information.

3.2.2 WATER USE

The Act's definition of water use in section 21 is very broad. It relates to the consumption of water as well as to activities that may affect water quality and the condition of the resource itself. Water use includes -

- Taking (abstracting) water from a water resource (s21(a));
- Storing water (s21(b));
- All aspects of the disposal of waste in ways that could impact on water resources, including –
 - Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall^[1] or other conduit (s21(f));
 - Disposing of waste in a manner that may impact detrimentally on a water resource (S21(g)); and
 - Disposing in any manner of water that contains waste from, or which has been heated in, any industrial or power generation process (s21(h)).
- Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people (s21(i)).
- Making changes to the physical structure of watercourses^[2], including –
 - Impeding or diverting the flow of water in a watercourse (s21(c));
 - Altering the bed, banks, course or characteristics of a watercourse (s21(j)).
- Certain activities that may affect the quantity or quality of water in the resource, namely –
 - Engaging in a stream flow reduction activity contemplated in section 36 (s21(d));

The use of land for afforestation for commercial purposes is the only stream flow reduction activity declared thus far^[3]. The Department will, however, investigate other land-based activities at a local, catchment or regional level and, where these are demonstrated to result in a significant reduction in stream flow, will declare them, after public consultation, as stream flow reduction activities in accordance with section 36.

- Engaging in a controlled activity identified as such in section 37(1) or declared, after public consultation, under section 38(1) (s21(e)).
- Using water for recreational purposes (s21(k)).

This broad definition of water use applies throughout the National Water Resource Strategy (NWRS). It applies to surface water wherever and in whatever form it occurs, and to groundwater where the section 21 definition is applicable.

3.2.3 AUTHORISING WATER USE

3.2.3.1 Types of authorisations

Schedule 1 of the Act^[4] permits the use of relatively small quantities of water, mainly for domestic purposes (including non-commercial gardening and stock watering), but also allows use in emergency situations and for certain recreational purposes.

Users must have lawful access to the resource in order to exercise the Schedule 1 entitlement. Use is also subject to any restrictions or prohibitions imposed by other relevant laws, ordinances, bylaws and regulations.

The Act does not specify generally applicable numerical limits to any of the Schedule 1 uses. However, the extent of such uses must be reasonable with regard to users' needs and not be excessive in relation to the capacity of the resource and the needs of other users. The Department will regularly assess the extent of use under Schedule 1 with a view to specifying limits for the various aspects of the schedule. The limits will differ for different parts of the country. Item 2(e) of Schedule 3 allows a catchment management agency (see Part 5 of this chapter) to place limits on the taking of water after having notified and consulted Schedule 1 users.

There is no formal requirement for users to register a Schedule 1 use. Catchment management agencies may impose limits on them where it is necessary in particular areas.

A general authorisation allows limited, but conditional, water use without a licence.

Limits are placed on water use under general authorisations depending on the nature of the use and the capacity of the resource to accommodate the use without significant degradation. For most water uses the extent of use differs in different parts of the country, since the quantity of water available for use and its quality varies widely across the country. Certain parts of the country may be excluded from general authorisations because water resources are already fully utilised. For instance, permissible rates of abstraction of groundwater under general authorisation - see below - varies from zero in catchments in the west and north to as much as 750m³ per hectare per annum in some catchments in the southern and eastern parts of the country.

In addition to the limits placed on use, additional conditions relating, for instance, to monitoring and reporting requirements may be attached to general authorisations in terms of section 29 of the Act. General authorisations may require the use to be registered with the relevant responsible authority, but may exempt some users from the requirement to register.

General authorisations must be made widely available for comment before they are established by means of a Notice being published in the *Government Gazette* and by taking whatever other steps are necessary to bring the Notice to the attention of users and other interested persons. General authorisations apply for a limited time period and may be reviewed and amended during this time. After expiry they may be revised to suit changed circumstances, or they may be extended.

Progress with general authorisations is as follows -

- Following a programme of public consultation, general authorisations were established by Government Notice No. 1191 on 8th October 1999 for the following water uses:
 - The taking of water from a water resource (section 21(a)) and storage of water (section 21(b)). Valid for five years after the date of publication with review at intervals of two years.
 - Engaging in a controlled activity (section 21(e)): Irrigation of any land with waste or water containing waste generated by any industrial activity or by a waterwork (section 37(1)(a)). Valid for three years after the date of publication with review at intervals of one year.
 - The discharge of waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit (section 21(f)), and the disposing in any manner, of water that contains waste from, or which has been heated in, any industrial or power generation process (section 21(h)). Valid for five years after the date of publication with review at intervals of two years.
 - Disposing of waste in a manner that may detrimentally impact a water resource (section 21(g)). Valid for five years after the date of publication with review at intervals of two years.

Following a programme of public consultation revisions to the above general authorisations were published in the *Government Gazette* on 26th March 2003 under Notice No. 399. The validity of the revised general authorisations after the final date of publication in the Government Notice is five years in all cases, with review at intervals of three years.

- Following a programme of public consultation, general authorisations were established by Government Notice No. 398 on 26th March 2003 for the following water uses. The validity of the revised general authorisations after the final date of publication in the Government Notice is five years in all cases, with review at intervals of three years.
 - Impeding or diverting the flow of water in a watercourse (section 21(c)).
 - Altering the bed, banks, course or characteristics of a watercourse (section 21(i)).
 - Removing, discharging or disposing of water found underground (section 21(j)).
- Following consideration of the necessity for and practicality of general authorisations for the following uses, draft general authorisations may be published for comment in due course:
 - Commercial afforestation activities as a stream flow reduction activity (section 36(1)(a) and section 21((d)).
 - Recreational use (section 21(k)).

A licence to use water

The Act's provisions in respect of Schedule 1 use and use under general authorisations are primarily intended to reduce the administrative effort of authorising every use in the country individually. However, any water use that exceeds a Schedule 1 use, or that exceeds the limits imposed under general authorisations, must be authorised by a licence.

As a transitional measure the Act permits water use that was lawfully exercised under any law preceding the introduction of the Act, termed *existing lawful water use*, to continue under existing conditions until such time as it is formally licensed.

3.2.3.2 Water use licences

A licence to use water^[5] -

- May only be issued by a responsible authority, to which a prospective user must apply;
- Replaces all previous entitlements, if any, to use water for the purpose specified in the licence;
- Is specific to the user to whom it is issued and to a particular property or area;
- Is specific to the use or uses for which it is issued;
- Is valid for a specified time period, which may not exceed 40 years;

- May have a range of conditions attached to it; and
- Must be reviewed by the responsible authority at least every five years.

Box 3.2.1: Water for productive livelihoods

The objectives of the Act are, among other things, to meet the basic human needs of present and future generations, to promote equitable access to water, and to redress the results of past racial and gender discrimination. The Department is committed to achieving these objectives, and particularly to ensuring that water management strategies contribute to the eradication of poverty.

Although significant progress has been made in addressing the backlogs in water services, the provision of water to meet basic human needs does not make allowance for water for income-generating activities.

Similarly, whilst prioritising allocations of water for emerging farmers and small grower forestry schemes, and revitalising defunct irrigation schemes has the potential to provide livelihoods for many people in rural areas, these do not address the needs of the large numbers of people who require water for small-scale activities such as, for instance, brick making, rearing poultry and growing produce for local sale. The quantities of water required are relatively small - research in small villages indicates that livelihoods can be significantly enhanced by the availability of 50 to 100 litres per household day.

Although Schedule 1 provides for the use of small quantities of water without the need for further administrative authorisation it is restricted to domestic uses such as food gardens and domestic stock watering. As the Act currently stands water use under Schedule 1 supports subsistence activities but does not allow water to be used for commercial purposes

The requirements for water for small-scale uses in rural areas will be quantified during compulsory licensing (see below), and the Department will investigate ways of making secure and cost effective supplies of water available without placing unnecessary administrative burdens on the users.

The requirements for water need not necessarily be met via piped supplies or using water abstracted from rivers. Rainwater harvesting from roofs or other hardened surfaces, using tanks, small check dams or catchpits can supplement more conventional sources of supply, and more use can be made of groundwater. Soil moisture can be retained on cultivated land and infiltration can be increased by contouring or constructing other micro water retaining structures, which have limited effects on water resources or downstream users.

The Department will work closely with other government agencies, particularly agricultural extension services, and in partnerships with non-governmental organisations and the private sector to explore possible options and ensure that appropriate interventions are implemented.

3.2.3.3 Water use and the Reserve

It is important to note that the Reserve (see Part 1 of this chapter) has priority over all water uses and that the requirements of the Reserve must be allowed for before any use is licensed. Authorisation of all water use in terms of a licence is therefore conditional on a Reserve determination being carried out, and the requirements of the Reserve being taken into account when determining the water available for allocation. However, where water is already allocated for use, the requirements of the ecological Reserve may be met over time by progressively adjusting allocations.

Unlike the ecological component of the Reserve that remains in the water resource, the basic human needs Reserve^[6] will be abstracted from the resource in order to be used. Although a water services institution requires a licence for the total quantity of water it takes from a resource to supply its consumers, the responsible authority may not refuse to authorise the quantity required to meet basic human needs, although it may specify the resource from which it is to be obtained. One of the purposes of the licence is to identify the source of the water for basic human needs^[7], particularly where the source is remote from the point of use, as is the case in some of the larger, multi-catchment water supply systems.

No Reserve determinations are required for Schedule 1 use, and the requirements of the Reserve are taken into account in determining the limitations on and conditions for use under general authorisations.

3.2.3.4 Applications for licences

Water use licences give existing or prospective water users authorisation to use water, or to access water resources, for beneficial purposes. Applications may either be made individually or generally as part of compulsory licensing, as discussed in the next section.

In general, licences will be applied for individually by new users, by existing users who wish to increase or change their use (for instance, in areas where compulsory licensing is not scheduled for some time, where existing water use has not yet been verified, and where there is sufficient available water) and by existing users who wish to continue their use in terms of an existing limited-duration authorisation (for instance, a permit to discharge waste or water containing waste into a water resource). Most existing users will acquire licences during compulsory licensing.

A person who wishes to use water must apply to a responsible authority for a licence to do so. A detailed procedure for individual licence applications has been established, which begins with discussions with the applicant about the proposed use and culminates in a decision to issue a licence or to refuse the application. Applicants can request technical, administrative and financial assistance from the responsible authority to make their applications. Responsible authorities may make a reasonable administrative charge for processing applications, but they may dispense with this charge at their discretion in deserving cases.

3.2.3.5 Compulsory licensing

The general, compulsory licensing of existing and potential new water users will be undertaken in accordance with the requirements of Chapter 4, Part 8 of the Act. Section 43(1) sets out criteria for assessing the necessity for compulsory licensing^[8] and provides for such exercises to be carried out progressively over time, in different parts of the country and according to the circumstances prevailing in particular areas or water resources. Because all the types of water use described in section 21 are inter-related to some degree it will in most cases be desirable to consider calling for licence applications for all water uses in each identified area at one time, rather than dealing with each individual type of water use separately.

Compulsory licensing will be carried out in areas defined by catchment or groundwater aquifer boundaries. Approximately 100 surface and groundwater areas have been identified across the country as a whole and a multi-year programme based on the water-related needs of each area indicates the likely order in which the Department intends to proceed with compulsory licensing (see Part 8 of this chapter).

The process for compulsory licensing as it is described in the Act is as follows:

- Existing use and its lawfulness is verified (see below).
- The responsible authority issues a notice calling for licence applications, which is also sent to all water users who took part in the registration process (see below). The responsible authorities must also identify other prospective users, especially from marginalised or disadvantaged groups and communities who have not previously had access to water resources, but who may wish to do so, to ensure that available water is allocated fairly.
- Users and prospective users prepare and submit licence applications. The Act *requires* users to submit applications, and failure to do so could result in the loss of any entitlement enjoyed under previous legislation.
- The responsible authority evaluates all licence applications.

- The responsible authority develops possible solutions to balance or reconcile water requirements with water availability, whilst meeting requirements for the Reserve and water quality (See Box 3.2.2).
- The responsible authority invites public comment on a proposed allocation schedule, ensuring that it is brought to the attention of all interested persons and giving them an opportunity to object to the proposed allocations.
- After considering all comments and objections the responsible authority must prepare and publish a preliminary allocation schedule. Anyone whose objection to the preliminary allocation schedule was unsuccessful has the right to appeal to the Water Tribunal in terms of Chapter 15 of the Act (see Part 5 of this chapter). If an appeal is successful, the preliminary allocation schedule must be amended.
- The responsible authority publishes the final allocation schedule in the *Government Gazette*.

As soon as reasonably practicable after the final allocation schedule has been published the responsible authority must issue licences to water users in accordance with its provisions.

Procedures to implement the process are being developed. Users will be consulted throughout the process.

Box 3.2.2: Development of solutions to balance water requirements and water availability

In each surface and groundwater area it is likely that there will be a number of possible solutions to balance or reconcile water requirements with water availability.

The determination of water availability (see Chapter 2) must take account of the requirements of resource quality objectives and the Reserve, which will be determined for each possible management class, water to meet international rights and obligations, a "contingency" to meet projected future water requirements including possible transfers of water to another water management area, and water use of strategic importance, all of which are the Minister's responsibility (see Part 5 of this chapter).

Water requirements include water use authorised by licences already issued under the Act, existing lawful uses that have been verified and for which applications have been received, and new water uses for which applications have been received. It may, however, be necessary to allow for additional water requirements to achieve equity of access (to support rural development, for instance) if the responsible authority has reason to believe that insufficient provision has been made for this purpose in applications received from users during the call for licence applications.

The process will be relatively complex, and it will be necessary to develop practicable approaches to modelling reconciliation options and their implications. Models will require detailed, up-to-date information on water use and water availability at a scale equal to or less than the quaternary catchment¹. The Department will establish norms and standards for modelling to ensure a consistent approach by all catchment management agencies.

The process of determining reconciliation solutions for compulsory licensing is closely related to the process of compiling a catchment management strategy, in that much of the information required for the latter must be compiled and analysed in the former. The Department will therefore ensure that the two processes are closely co-ordinated.

The output from the compulsory licensing process will, in most cases, be the publication for comment of a proposed allocation schedule, representing the preferred reconciliation solution, the associated management class(es), the Reserve(s) and resource quality objectives for the resource, and a proposed catchment management strategy.

¹ South Africa is divided into approximately 1 950 quaternary catchments.

3.2.3.6 Evaluation of licence applications

All licence applications, whether individual or compulsory, must be evaluated against the factors specified in section 27 of the Act. The responsible authority must carefully consider all of these factors to determine the extent to which a proposed water use satisfies the Act's requirements

for equity, sustainability and efficiency. A detailed procedure is being developed to enhance the evaluation of licence applications.

Although the application procedure requires users to provide information about the proposed use, it may become clear during the evaluation process that more information is needed. The responsible authority may, to the extent that it is reasonable to do so, require the applicant to obtain and provide the information, or it may itself undertake the necessary investigations to obtain such information. In certain cases the applicant may be granted financial assistance for the investigations.

In addition, at any time during either the individual or compulsory application process, the responsible authority may require the applicant to make the details of the application known to relevant organs of State, all interested persons and the general public, and to invite objections to the application. This is aimed at determining the extent to which the proposed use may be in conflict with other government policies or laws, or may adversely affect the interests of other parties.

3.2.3.7 Requirements for licences and licence conditions

Sections 28 and 29 of the Act respectively describe the essential information that must be included in a licence and the conditions under which the water use is authorised.

One of the most important attributes of a licence is its period of validity. Limited-period licences are intended to provide water users with a level of security appropriate to the nature of their water use, whilst at the same time providing responsible authorities with the flexibility to manage changes in water availability, or water use needs and priorities.

Whilst the evaluation procedure for licence applications will contain broad guidelines for determining the licence period, each water use is unique and the guidelines must not be regarded as a rigid prescription or recipe. Considerations in determining a licence period include the following:

- For agricultural activities, the nature of the proposed crop, particularly whether it is annual or perennial.
- The physical infrastructure necessary to use the water or in which water will be used, its life span, the capital investment and associated loan redemption period.
- The extent to which infrastructure has been established to process the products of water use and whose continued viability depends on the water use continuing. Examples are timber processing plants, sugar mills and canning factories.
- The social benefits of the water use, such as the extent to which people depend on the water use for employment.

Under certain circumstances water may be available in excess of current requirements and the responsible authority may issue short-term licences until demand increases. For instance, where a dam or an inter-basin transfer scheme has been commissioned to augment water supply for anticipated growth in urban and industrial requirements, water may be available in the short term for agricultural use until the increased demand in the target sector(s) occurs.

In addition to the licence period, water use may be subject to a range of other conditions, described in section 29 of the Act. Together these are intended to ensure that the total use from a particular water resource does not unreasonably prejudice the integrity of the resource, that individual uses do not unreasonably prejudice other users, and that water resources are effectively managed.

Some conditions place limits on certain water uses, such as the volumes and timing of abstractions, the volume that may be stored, or composition of discharges. Other conditions are specific to particular uses, for example measures to limit stream flow reduction due to land-

based activities and methods to quantify stream flow reduction. Others relate to resource or infrastructure management, for instance adherence to certain management practices, the requirement to prepare and adhere to a water management plan, or the establishment of monitoring systems and the provision of information.

As far as possible, conditions of use will be determined by negotiation and agreement with users. Every case will be decided on its individual merits. The conditions described in section 29 may also be attached to general authorisations.

3.2.3.8 Compliance with conditions of water use

All water users are required to adhere to the conditions of use attached to general authorisations and licences, and the responsible authorities are required to ensure that they do so.

There are a number of provisions in the Act that enable responsible authorities to enforce compliance, briefly as follows:

- A responsible authority may, when a contravention of a condition of water use comes to its attention, issue a notice directing the user to rectify the contravention.
- If the user fails to comply with the notice the responsible authority may suspend or withdraw the entitlement to use water. The user must, however, be afforded the opportunity to make representations on the intention to withdraw or suspend the entitlement.
- Failure to comply with any condition of use is an offence under the Act and the responsible authority may choose to prosecute an offending user who, if convicted, may be liable to a fine or imprisonment.

It will, however, be preferable for water users to comply voluntarily with reasonable conditions of use, which have been co-operatively determined and mutually agreed to by users and responsible authorities. Under these circumstances it will be necessary for responsible authorities to resort to enforcement by legal command-and-control measures only in exceptional cases.

A comprehensive compliance management strategy will be developed during the course of the first compulsory licensing exercise (see Part 8 of this chapter) and implemented when a significant number of licences have been issued in terms of the Act

3.2.3.9 Review and amendment of licences

It is important to note that the conditions attached to licences will not necessarily remain unchanged throughout the life of the licence. Any condition, except the licence period, may be amended on review, if such amendments are necessary to maintain the integrity of the water resource, achieve a balance between available water and water requirements, or accommodate changes in water use priorities (section 49). A licence must be reviewed at the times specified in the licence and review periods may not exceed five years.

Licence conditions for all similar uses from the same water resource must, however, be amended in an equitable manner. Reviews must therefore be general and must be undertaken in consultation with users. Users whose licence conditions are changed will be afforded sufficient time to adjust their water use to the revised conditions, the adjustment period being appropriate to the nature of the use and the magnitude of the change(s). At each general review the responsible authority may, after considering all relevant factors, extend the licence, but only by the length of a single review period.

Where a user considers that a reduction in existing lawful use, the refusal to grant a licence during compulsory licensing, or an amendment to her or his water use on review will severely prejudice the economic viability of the water use activity, a claim for compensation of financial loss may be made to the Water Tribunal. The amount of compensation must be determined in accordance with section 25(3) of the Constitution. However, no compensation will be paid where

changes in water use are necessary to provide for the requirements of the Reserve, to rectify an over-allocation of water from the resource, or to rectify an unfair or disproportionate water use (section 22(7)).

3.2.3.10 Registration of use

Authorisation of all water uses throughout the country that require licences is a considerable task and will take some time to complete (see Part 8 of this chapter). As an essential preliminary step towards licensing, and to enable water pricing to be implemented^[9], a countrywide process has been undertaken to register existing water uses. The registration process will ultimately capture information about the location and extent of all section 21 uses. However, because water use charges under the pricing strategy may at present only be made for abstraction, storage and stream flow reduction activities (commercial afforestation), registration has concentrated on these three water uses. Other water uses will be registered in due course.

The formal time period for the registration of water use closed at the end of June 2001. As more than 80 per cent of the total volume of water used in the three water use categories for which charges could be made had been registered at that time, the Department was satisfied that a sufficiently high number of users had been captured to enable water use charges to be made equitably. Unregistered users may now be liable for a penalty charge for late registration, and risk losing their existing entitlements.

The registration data is currently being captured on the Water Authorisation and Registration Management System (WARMS - see Part 6 of this chapter) and registration certificates are being issued. A registration certificate is not, however, a licence to use water, and does not confer legitimacy on an unlawful water use.

3.2.3.11 Verification of existing water use

In due course, before undertaking compulsory licensing, responsible authorities will verify the extent and lawfulness of all existing water uses. Verification will be prioritised in areas where registration information indicates that existing use exceeds the capacity of the resource. However, *ad hoc* verifications of individual uses may also be undertaken if it is necessary to license the existing use in order, for instance, to facilitate the transfer of a water use authorisation (see below). In the event that a water use is found to be unlawful, steps will be taken to remedy the situation.

Existing use will also be verified to extend registration to all water users. Various techniques will be used for verification, including site inspections, aerial surveys and, where appropriate, satellite imagery.

3.2.3.12 Transfer of water use authorisations

In section 25 the Act provides for two distinctly different circumstances under which water use authorisations may be transferred.

The first refers to the temporary transfer of water authorised for irrigation, either on the same property for a different use or to another property for the same or a similar use. In the latter case, the two properties may, but need not necessarily be owned by the same person. Although every case will be considered on its merits and within its local context, in general temporary transfers will be granted for one year only, but the user will have the option of applying for an extension of a further year. Applications for permission to effect a transfer must be made to the water management institution that has jurisdiction in the area.

The second circumstance refers to permanent transfers, which may be effected by one user offering to surrender all or part of an allocation to facilitate a licence application by another prospective user. Transfers of this nature constitute trade in water use authorisations, and require new licence applications, which will be subject to all the relevant requirements of the Act

relating to applications for licences, including the need for a Reserve determination if one has not already been carried out. Permanent transfers become effective only when the new licence is granted. They may be authorised only by a responsible authority, which may attach different conditions to the new licence than were attached to the surrendered licence. One such condition may be that the new user must pay compensation to the original licence holder.

Transfers, whether temporary or permanent, will only be permitted where both the original and the transferred water use are from the same water resource. Procedures have been developed to deal with such transfers and section 26 regulations may be written to provide a nationally consistent basis for transfers of this nature.

In addition, when land owned by a person to whom a licence has been issued changes ownership, section 51 of the Act permits the successor-in-title to continue with the water use under the conditions attached to the licence, provided the responsible authority is promptly informed of the new licensee's name.

3.2.3.13 Water use of strategic importance

Section 6(1)(b)(iv) of the Act requires the NWRS to make provision for water uses of strategic importance. These are uses that are considered to be of such critical importance to the nation that they must be authorised by the Minister (see Part 5 of this chapter) rather than by a catchment management agency.

One water use the Minister must authorise is the transfer of water from one water management area to another. The Minister may reserve water for such purposes once the quantities of water have been determined in respect of which a catchment management agency may, when empowered to do so, issue general authorisations and licences in its area of jurisdiction. Determination of the quantities of water for allocation in each water management area will also account for the quantities of water that must be made available in different areas on the same river - the areas along the Vaal and Orange Rivers, for instance. Indicative requirements for inter-water management area transfers in the future are provided in Appendix D.

The continued availability of electricity throughout the country from the national grid is essential for both social and economic development. Accordingly, all water that is taken from a water resource for the purpose of generating electricity for the national supply, or is stored at Eskom power generation facilities, wherever these are located, is regarded as water use of strategic importance, and will therefore also be authorised by the Minister, after the relevant catchment management agency or agencies and water services authority or authorities have been consulted.

It is important to note that this water use is limited to taking water from a water resource and storing water, that it will be evaluated against the same considerations as any other use, and that it will be subject to all relevant conditions. The discharge of waste or water containing waste into a water resource from Eskom facility, and all other water uses, will be authorised locally by the responsible authority (see Part 5 of this chapter).

These provisions do not relieve Eskom of the responsibility to acquire the necessary approvals from the relevant water services authorities to obtain water for industrial use^[10] at, and to dispose of industrial effluent from its generating facilities.

3.2.3.14 Using water for recreational purposes

The use of water for recreational purposes is a defined water use in the Act (see section 3.2.2 above) and is therefore subject to all relevant provisions that relate to water use, including the purpose, manner or extent of the use being limited or restricted by regulations in terms of section 26.

The recreational use of water resources has significant potential to contribute to national social and economic development. Accordingly, an approach is being developed^[11] to ensure that the use is equitable and sustainable, compatible with other water uses and within the capacity of the resource. The approach will include the development of the following -

- A Policy on Using Water for Recreational Purposes, which provides overall guidance and direction, and takes into account the requirements of other relevant policies and legislation.
- An Implementation Programme, which will include the creation of awareness and education, the establishment of representative management institutions, the preparation of guidelines on, for example, financial aspects (including charges for access and use) and benefit streams and co-operative governance, and the development of performance management and compliance measures.
- A Sustainable Utilisation Planning Procedure for the preparation of access and utilisation plans and management structures aimed at ensuring that all stakeholders, including affected communities, users and resource managers, have the opportunity to participate in planning and implementation.

The use of government waterworks for recreational purposes

Section 113 of the Act empowers the Minister to make the water of government waterworks and the surrounding State-owned land, particularly at State-owned dams, available for recreational purposes^[12]. Special attention will be given to policies governing access to and use and development of the water surface of State-owned dams and surrounding land for recreational purposes in these cases.

Regulations are being prepared in terms of section 116 of the Act relating, among other things, to the safety and protection of government waterworks and the safety and security of persons using such waterworks for recreational purposes. Existing regulations made under the 1956 Water Act will continue in force until they are replaced by the new regulations.

3.2.3.15 Regulations on water use

The Act is the broad legal framework for water resource management, but it generally does not provide all the details that enable its requirements to be implemented in practice. Implementation details are found in regulations which, when they are formally established by Government Notice, become part of the law. The Act empowers the Minister to make regulations on a wide range of matters specified in the Act. All regulations must be published for public comment and they must subsequently be reviewed by committees of the National Assembly and the National Council of Provinces.

Regulations that may be made relating to water use are described in section 26. Progress in this regard is as follows -

- Government Notice No. 704 of 4 June 1999, National Water Act, 1998 (No. 36 of 1998): Regulations on the use of water for mining and related activities aimed at the protection of water resources.
- Government Notice No. 1352 of 12 November 1999, National Water Act, 1998 (No. 36 of 1998): Regulations requiring that a water use be registered. (Related document: Delegation of powers and duties in terms of regulation No. R. 1352 of 12 November 1999 requiring that a water use be registered in terms of the National Water Act, 1998).
- Government Notice No. 1228 of 29 August 2003, National Water Act, 1998 (No. 36 of 1998) invited written comments to be submitted on the following proposed regulations -
 - Impeding or diverting the flow of water in a watercourse (section 21(c));
 - Altering the bed, banks, course or characteristics of a watercourse (section 21(i)); and
 - Removing, discharging or disposing of water found underground it is necessary for the efficient continuation of an activity or for the safety of people (section 12(j)).

The proposed validity of the regulations after the final date of publication in a Government Notice is five years in all cases, with review at intervals of three years.

Other regulations that are in preparation, or are contemplated in the near future, concern the following issues -

- Limiting or restricting the purpose, manner or extent of water use in respect of using water for recreational purposes.
- The outcomes or effects of management practices for waste treatment, aimed at encouraging the reduction of wastes at source, recycling, detoxification and neutralisation.
- Transactions in respect of authorisations to use water (trade).

3.2.4 WATER QUALITY

This section gives an overview of the approaches to authorising water use that are specific to the water quality aspects of water resources, including all aspects of the disposal of waste or water containing waste, either directly into water resources or in ways that may detrimentally impact on water resources.

Sources of pollution are broadly categorised as point sources, such as discharges from sewage treatment works or industrial sites, and diffuse sources, for example settlements without a sewerage system, and surface runoff from agricultural land to which fertilisers are applied. In addition, because of their potential to impact on surface and groundwater resources, the Department is, in terms of Section 20 of the Environmental Conservation Act, 1989, and by agreement with the Department of Environmental Affairs and Tourism, responsible for overseeing the management of sites where waste is disposed onto land. However, Parliament has approved an amendment to the ECA that transfers this responsibility to DEAT. The transfer of the function will take place according to a timeframe agreed between the departments, with the intention of effecting the transfer by April 2005. Issuing of permits by DEAT requires concurrence by the Department with regard to water quality aspects.

Specific actions in terms of resource directed measures that require attention at national level in respect of water quality management include the following -

- Formulation of objectives for managing sources of pollution and associated single source interventions (see Part 1 of this chapter for a discussion of source-directed controls).
- Benchmarking water resource quality.
- Identification of emerging threats to the water resource and prioritisation for action.
- Establishing priorities in relation to, for instance, remediation of water resources and degraded land as a focus for regulation using source-directed controls.

3.2.4.1 Implementing source-directed controls

Decisions about the nature and extent of permissible water uses and developments that may pollute water resources are guided by a structured decision-making framework that balances the need to protect water resources and the need for social and economic development.

The preferred approach is to prevent the pollution of water resources. In those cases where the discharge of pollutants into water resources is unavoidable the emphasis is on minimising the pollution and its effects. Decisions to authorise such discharges are based on consideration of their social, economic and ecological impacts. Where pollution has already caused degradation of water resources, or where contaminated land areas pose a threat to water quality, improvements (remediation) will be effected as appropriate.

Each application for authorisation to discharge wastes into water resources will therefore be preceded by an assessment of the probable impacts of the discharge on the water resource and

other water users. In the case of hazardous wastes the aim is to prevent discharge altogether or, if this is not possible, to minimise the extent of the discharge and its impacts. For non-hazardous wastes the risk-based resource water quality objectives approach will continue to be used. This approach assumes that the water environment has a finite and quantifiable capacity to assimilate non-hazardous wastes discharged into it without violating predetermined water quality objectives in accordance with its class. The assimilative capacity will be different for each water resource and for each management class. Where, after all relevant factors have been considered, assimilative capacity is sustainably available it must be equitably shared among all water users.

Source-directed controls that may be applied to prevent or minimise pollution include recycling or re-use of waste, water recovery, detoxification, neutralisation and treatment, and the introduction of cleaner technology and best management practices.

Preventing pollution

Wherever possible, source-directed controls will be promoted to prevent water resources being polluted or degraded, particularly for hazardous wastes.

Minimising pollution

The discharge of waste or water containing waste to water resources, or the disposal of waste, will be permitted only under the following conditions -

- Pollution costs are, as far as possible, to be borne by the discharger (internalised), and not passed on (externalised) to the water resource or to other water users.
- Applicable national norms and standards will apply. The current General and Special Effluent Standards for discharge of waste or water containing waste and the Minimum Requirements for Waste Disposal will continue to apply until new standards are developed and implemented
- For other water uses that may impact on water quality, such as impeding or diverting the flow of water in a water course, measures to meet resource quality objectives will be stipulated in guidelines and directives.
- If, in specific situations, the applicable minimum requirements or standards are not sufficient to ensure suitable water quality, standards stricter than the minimum requirements or standards will be prescribed.

Standards for discharges will be prescribed by regulation. Relaxation of standards will be contemplated only where there are pressing social or economic reasons to do so, and will be considered in situations where it is evident that -

- The enforcement of the measures could result in notable impairment of social or economic development or related environmental values; and
- The relaxation of requirements or standards could facilitate or contribute to enhanced participation and benefit-sharing arising from water use by those who were historically disadvantaged by racial and gender discrimination; but
- Where resource quality will not be unacceptably degraded.

Whilst the overall intention is to prevent further degradation of the quality of the country's water resources and to effect improvements where possible, limited and short-term degradation of the water quality of specific water resources could be allowed if it can be demonstrated with confidence that the degradation will not cause irreversible damage, and that pollution costs will not be externalised to other users of the resource.

Decision-making in this regard will also be guided by the following principles -

- Strict controls to protect human health will be applied.
- Concessions will apply for a defined period of time.
- Relevant stakeholders must be involved in the decision-making process.

Remediation

Remediation strategies will be developed to effect improvement in the condition of degraded and impaired water resources, or contaminated land areas such as abandoned mines, as required by the resource quality objectives adopted for the water resource.

Clean-up levels and targets, remediation approaches and measures, and the prioritisation of remediation focus and effort will be dictated primarily by appropriate risk-based approaches. However, rule-based best management practice measures could be appropriate and a requirement in some cases. Implementation of the relevant financial provisions of the Act to cover remedial actions will form part of the remediation strategy.

Until the remediation strategy has been developed and implemented, the Department will apply the regulatory instruments that are currently available to handle situations requiring remediation.

Notes to Chapter 3, Part 2

¹ The Department is developing a Policy for the Treatment and Disposal of Land-Derived Waste and Water Containing Waste in the Coastal Areas of South Africa, and is preparing an amendment to the National Water Act to facilitate control of waste discharged into the sea.

² "Watercourse" means a river or spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which, or from which, water flows, and any collection of water which the Minister may, by notice in the *Gazette*, declare to be a watercourse. (Section 1(xxiv)).

The Conservation of Agricultural Resources Act (No. 43 of 1983) has as one of its objectives " ... the combating and prevention of erosion and weakening or destruction of the water sources ... " that also relates to alterations to the riparian zones of watercourses.

³ The use of land for afforestation which has been or is being established for commercial purposes was declared a stream flow reduction activity in the Act to retain the water-related control over commercial afforestation under the Afforestation Permit System that was introduced in 1971. The system was reviewed and revised in consultation with the forest industry and other stakeholders shortly before the Act was promulgated.

⁴ Schedule 1 - Permissible Use of Water [Sections 4(1) and 22(1)(a)(i) and Item 2 of Schedule 3]: (1) A person may, subject to this Act - (a) take water for reasonable domestic use in that person's household, directly from any water resource to which that person has lawful access; (b) take water for use on land owned or occupied by that person for - (i) reasonable domestic use; (ii) small gardening not for commercial purposes; and (iii) the watering of animals (excluding feedlots) which graze on that land within the grazing capacity of that land, from any water resource which is situated on or forms a boundary of that land, if the use is not excessive in relation to the capacity of the water resource and the needs of other users; (c) store and use run-off water from a roof; (d) in emergency situations, take water from any water resource for human consumption or fire fighting; (e) for recreational purposes - (i) use the water or the water surface of a water resource to which that person has lawful access; or (ii) portage any boat or canoe on any land adjacent to a watercourse in order to continue boating on that watercourse; and (f) discharge - (i) waste or water containing waste; or (ii) run-off water, including stormwater from any residential, recreational, commercial or industrial site, into a canal, sea outfall or other conduit controlled by another person authorised to undertake the purification, treatment or disposal of waste or water containing waste, subject to the approval of the person controlling the canal, sea outfall or other conduit. (2) An entitlement under this Schedule does not override any other law, ordinance, bylaw or regulation, and is subject to any limitation or prohibition thereunder.

⁵ Licences to use water should not be confused with the licences required in terms of Chapter 12 of the Act - Safety of Dams, which relate to the construction, enlargement and abandonment of and alterations to dams, and to impounding water before putting dams into operation.

⁶ In determining the Reserve an allowance of 25 litres per person supplied from the resource per day is made for the basic human needs component, in accordance with prevailing water services policy. This is equivalent to free basic water, provided by water services institutions in terms of government policy, of six kilolitres per month for a household of seven to eight people. Should this quantity be increased in future, the Reserve will be re-determined.

- ⁷ Section 6(1)(b) of the Act - Contents of the national water resource strategy - requires the NWRS to "provide for the Reserve and identify, where appropriate, water resources from which particular requirements must be met".
- ⁸ Section 43 - Compulsory licence applications: (1) If it is desirable that water use in respect of one or more water resources within a specific geographic area be licensed - (a) to achieve a fair allocation of water from a water resource in accordance with section 45 - (i) which is under water stress; or (ii) when it is necessary to review prevailing water use to achieve equity in allocations; (b) to promote beneficial use of water in the public interest; (c) to facilitate efficient management of the water resource; or (d) to protect water resource quality, the responsible authority may issue a notice requiring persons to apply for licences for one or more types of water use contemplated in section 21.
- ⁹ Registration of a water use in terms of a section 26 regulation renders the user liable to pay water use charges in respect of the use: see section 59(2).
- ¹⁰ This is required in terms of section 7 of the Water Services Act, 1997, in which the definition of industrial use (section 1(ix)) includes the use of water for generating electricity.
- ¹¹ The approach to using water for recreational purposes is being developed in consultation with key stakeholders including the departments of Environmental Affairs and Tourism, Land Affairs, Public Works, Trade and Industry, and Transport, and National Treasury and Sport and Recreation South Africa.
- ¹² The part of this provision that relates to the use of the land surrounding State-owned dams for recreational purposes is in conflict with legislation administered by the Department of Land Affairs and, accordingly, the use of such land for these purposes will be authorised with the concurrence of the Minister of Agriculture and Land Affairs.

CHAPTER 3

PART 3 - WATER CONSERVATION AND WATER DEMAND MANAGEMENT

(There is no specific Chapter or Part of the National Water Act in which there are explicit provisions for water conservation and demand management. However, the Act's definition of conservation^[1] makes it clear that water conservation and water demand management measures are an essential component of water resource management)

3.3.1 INTRODUCTION

The options for further augmentation of water supply by the development of physical infrastructure are limited (see Chapter 2) and in future attention will have to be on managing the increasing demand for water in order to achieve a sustainable long-term balance between water availability and water requirements. Although there will be further construction of dams and related infrastructure in some parts of the country (see Chapter 2 and Appendix D), problems of water availability will in future be addressed by using an appropriate mix of supply- and demand-side measures.

Water conservation and water demand management relate to the efficient and effective use of water and to the minimisation of loss and wastage of water, and are important elements of the approach to the care and protection of water resources. Many of the Act's provisions and requirements are thus either directly related to or refer to water conservation, for instance -

- Resource protection measures (discussed in Part 1 of this chapter).
- Conditions for water use in general authorisations and licences (discussed in Part 2 of this chapter).
- Water pricing as an incentive for efficient use (discussed in Part 4 of this chapter).
- Management of land-based activities via stream-flow reduction and controlled activities (discussed in Part 2 of this chapter).
- Control of invasive alien vegetation (discussed later in this part).

3.3.2 THE NATIONAL WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGY

The Department is developing a National Water Conservation and Water Demand Management (WC/WDM) Strategy, and subsidiary strategies for three identified water use sectors, namely water services, agriculture, and industry, mining and power generation. The strategies will outline measures and interventions aimed at encouraging and supporting water institutions and water users to increase the efficiency of their water use and reduce their demand for water. They are based on the premises that, first, many water users can maintain their quality of life, and achieve the desired outcomes or products from their water use, whilst using less water and, second, that significant reductions in water use can be achieved by minimising wastage and increasing the efficiency of water use by changes in behaviour and adopting water-saving technologies.

The strategies will not present rigid prescriptions to water institutions and users. The core objective of the strategies is to create a WC/WDM culture within all the water management and water services institutions defined in the National Water Act and the Water Services Act (catchment management agencies, water user associations, water services authorities, and bulk and retail water services providers such as water boards) and among water users. The Department will provide support to water institutions and help them to develop and implement strategies that suit their own circumstances and which are economically coherent and financially sound with regard to the costs and benefits of the proposed measures. Accordingly, an essential component of the National WC/WDM Strategy is a programme of communication, education, awareness creation and promotion, and the development of supportive networks.

Water demand management is not, however, concerned merely with reducing water use as an end in itself, as there are social, economic and environmental advantages to be gained from programmes designed to achieve sustained reductions in water use, such as -

- Water users are empowered to understand the value of water as a scarce resource, and to adopt a responsible attitude to its use.
- Water is made available for allocation to other uses, either within the particular sector or for competing uses, and for the Reserve.
- The necessity for capital investments in new infrastructure can be postponed, and increases in the cost of water to end-users delayed.
- The financial security of water institutions can be improved by reducing non-revenue demand - that is, unaccounted-for water caused by leakage from supply and distribution systems, and water wasted by non-paying consumers.

3.3.3 THE PRINCIPLES OF WATER CONSERVATION AND WATER DEMAND MANAGEMENT

The National WC/WDM Strategy is based on three fundamental principles, namely -

- **Water institutions should strive to supply water efficiently and effectively, minimise water losses and promote WC/WDM among their consumers.**
Water institutions responsible for supplying water to users should take steps to reduce leakage in their systems, and develop and implement measures to promote WC/WDM.
- **Users should not waste water and should strive to use it efficiently.**
Wasted water is water used without any direct benefit being derived. Inefficient use of water is water use that exceeds the accepted benchmark for the particular purpose, or water used where the derived benefit is sub-optimal. The Department will work closely with water institutions and representatives of water use sectors to develop benchmarks to enable users and institutions to understand and quantify their water requirements better, and to facilitate better management and regulation of water use.
- **WC/WDM should be an integral part of the planning processes for water resources management, water supply and the provision of water services.**
In situations of water shortage demand-side solutions will be considered alongside supply-side augmentation options. The participatory and consultative approaches to implementing WC/WDM will extend the planning process down the supply chain to the end user by requiring water institutions and water users to share the responsibility for ensuring the efficient use of water. In particular, where an inter-basin transfer of water is contemplated, there is an explicit requirement in the National Water Policy^[2] for water currently available in the receiving area to be used optimally, and for reasonable measures to be taken to conserve water before the transfer is effected.

3.3.4 SECTORAL STRATEGIES

3.3.4.1 Water services

An effective WC/WDM programme for the water supply and sanitation services sector is essential because, although it accounts for only about 15 per cent of total national water use (excluding water supplied to industries by water services authorities), it is the sector with the highest expected growth in demand. More efficient use of water will reduce the costs of purifying and distributing water to consumers and of the subsequent treatment of wastewater.

Water services institutions will be expected to determine their own targets and benchmarks for efficient water use. These will be included in their Water Services Development Plans^[3] and will be reviewed by the responsible authority (the Department or the relevant catchment management agency - see Part 5 of this chapter) during the water use licensing and review processes.

Measures to facilitate achievement of the strategy outputs for the water services sector will include the requirements for -

- Water services authorities to develop a WC/WDM strategy as part of their Water Services Development Plans in accordance with the model strategy developed by the Department; and
- Water boards to develop their WC/WDM strategies according to the model strategy developed by the Department and to submit them as part of their business plans^[4].

3.3.4.2 Agriculture

Irrigated agriculture accounts for about 62 per cent of water used in South Africa. Although there are areas where water use is highly efficient, there are significant losses in many distribution and irrigation systems, whilst substantial improvements can be achieved in others. Efficiency gains in the sector will make water available for the Reserve and for other uses.

The strategy will provide a framework of regulatory support and incentives designed to improve irrigation efficiency. It promotes the equitable and efficient use of water in the sector in order to increase productivity and contribute to reducing income inequalities among people supported by farming activities. The framework of action defined by the strategy is briefly described in the following outputs:

Strategy outputs

- Appropriate measures are implemented that bring about a reduction in water wastage.
- Water user associations and end users understand and appreciate the need to progressively modernise their water conveyance systems and irrigation equipment.
- Water allocation processes to promote the equitable and optimal utilisation of water.
- Preventive maintenance programmes are in place.
- Sufficient irrigation information is generated and is accessible to all stakeholders.
- Water management institutions and service providers implement audits from the water source to end users and beyond.

To facilitate achievement of the objectives consideration will be given to requiring water users in the agriculture sector who apply for water use licences to develop and submit to the responsible authority a water management plan in accordance with the *Implementation Guidelines for Water Conservation and Demand Management in Agriculture: Development of Water Management Plans*.

3.3.4.3 Industry, mining and power generation

The wellbeing of this sector is crucial to South Africa's economic development and it requires a high assurance of supply. The sector accounts for approximately 15 per cent of the total water used, including water used by industries supplied by water services authorities. There is nevertheless scope for more efficient use of water without impacting adversely on economic activity. The sector is also a major source of waste discharges into water resources. The strategy for the sector defines a framework of action that is briefly described in the following outputs:

Strategy outputs

- Ongoing water audits and water balances.
- Benchmarks for water use for various processes and industries.
- Reports on performance against benchmarks.

To facilitate the achievement of the above, industrial users who require a licence to use water (that is, users who draw their water direct from a water resource) may be required to develop

and submit to the responsible authority a Water Management Plan in accordance with guidelines that will be developed and made available by the Department. For those users who have to submit such a plan as part of their Environmental Management Plan, the Department may waive this requirement. Large industrial or commercial users who draw their water from a municipal supply system and do not have to obtain a water use licence from any water management institution will not have to submit a water management plan unless required to do so by the relevant water service authority or water services provider

3.3.4.4 Communication, community awareness, education and marketing

The Department has a unique role to play in programmes of education, developing community awareness and communication of WC/WDM. The Department will continue to implement projects in these areas to highlight the necessity of public participation in achieving the objectives of WC/WDM. The community awareness component will promote an understanding of and support for WC/WDM among the general public including communities and tertiary institutions. A schools-based education component will promote WC/WDM primarily among learners and school educators. A communications component will co-ordinate special campaigns, resources and events around WC/WDM in the various water sectors including water management and water services institutions.

3.3.5 CONTROL OF INVASIVE ALIEN VEGETATION

Recent estimates indicate that about 10 million hectares of land in South Africa are infested with invasive alien plants that out-compete and replace the natural vegetation. They are undesirable because they impact on biodiversity, ecological functioning and the productive use of land. There is evidence that they use more water than the natural vegetation they replace. The effect on runoff is similar to the deliberate planting of trees for commercial use, which is a declared stream flow reduction activity (see Part 2 of this chapter). Commercial forestry is regulated to minimise the extent of the runoff reduction, whilst alien vegetation is regulated by the Conservation of Agricultural Resources Act, 1983 (No. 43 of 1983), which does not adequately address the situation in State and communal land.

Preliminary estimates, largely based on the results of commercial afforestation catchment experiments, are that water use by alien plants is greater than that used by natural vegetation, and can result in significant reductions in runoff in some of the catchments where they occur. Clearing infestations, especially from the riparian zone, can increase stream flow. There are however considerable variations between sites, and also between species and growth types. Further work is being done to improve the accuracy of the estimates of both the extent of infestation and runoff reduction. The effects on groundwater also need to be quantified to obtain a complete picture of the hydrological effects. It is clear, however, that the problem is already significant and will worsen if no action is taken.

Since invasive vegetation affects the productive use of land it is a land management issue, with strong environmental considerations owing to its impact on biodiversity, its management must be approached in a co-ordinated multi-sectoral way. The approach to be used will be determined jointly by the Department of Environmental Affairs and Tourism, the National Department of Agriculture, and the Department of Water Affairs and Forestry.

Currently, under the Working for Water programme, clearing work is undertaken on State-owned land, such as in nature conservation areas, as well as on privately-owned land. Agreements are sought with landowners to ensure that the land is kept free of infestations of invasive alien vegetation after initial clearing has been completed. In cases where landowners are unwilling to enter into such agreements, regulations under the Conservation of Agricultural Resources Act are used to enforce follow-up work by the landowners. These regulations list the alien plants that must be removed from land, those that may be grown only with a permit and those that may not be sold or propagated. Enforcement is done in co-operation with government agriculture agencies.

In future land owners, custodians and managers, both private and public, should take responsibility for the control of alien vegetation in their areas. It is therefore the intention to move to a situation in the medium term in which the land managers, especially provincial conservation and agriculture departments, as well as private land owners, undertake alien vegetation control as a core element of their activities, with oversight by and support from the national programme. It will be the responsibility of public sector land managers to ensure that these activities are adequately funded.

From a water resource management perspective, alien vegetation control in specific catchments may be prioritised in catchment management strategies by considering the balance between water availability and water requirements, and the probable increase in runoff that will result from clearance. Where vegetation clearing activities contribute to improved water security the costs may be funded by water management institutions using water resource management charges on water users (see Part 4 of this chapter). This will be done in consultation with the relevant water resource managers, water users and other stakeholders.

Notes to Chapter 3, Part 3

- ¹ "Conservation" in relation to a water resource means the efficient use and saving of water, achieved through measures such as water-saving devices, water-efficient processes, water demand management and water rationing (NWA section 1(1)(v)).
- ² National Water Policy, 1997 - see section 6.6.3, final paragraph.
- ³ Each Water Services Authority is required, by section 12 of the Water Services Act, to prepare a Water Services Development Plan. Such a plan forms part of the Integrated Development Plans that municipalities must prepare in terms of the Municipal Systems Act, 2000 (No. 32 of 2000).
- ⁴ Each water board is required, by section 40 of the Water Services Act, to prepare a five-year Business Plan and submit it to the Minister.

CHAPTER 3

PART 4 – WATER PRICING AND FINANCIAL ASSISTANCE

(Provisions relating to water pricing and other financial aspects of water management are found in Chapter 5 of the National Water Act.

3.4.1 WATER PRICING

3.4.1.1 Introduction

The National Water Act (the Act) empowers the Minister, in consultation with the Ministry of Finance, and after consulting with the public, to establish a pricing strategy for any water use described in section 21. The Act provides for three types of water use charges as follows -

Funding water resource management. Activities such as information gathering, monitoring water resources and controlling their use, water resource protection (including waste discharge and the protection of the Reserve) and water conservation.

Funding water resource development and use of waterworks. The costs of the investigation, planning, design, construction, operation and maintenance of waterworks, pre-financing of development, a return on assets and the costs of water distribution.

Resource management and resource development charges are financial charges, which are directly related to the costs of managing water resources and supplying water from schemes and systems.

Achieving the equitable and efficient allocation of water. Economic incentives to encourage more efficient use of water, water conservation and a shift from lower to higher value uses.

This is an economic charge and relates to the value of water to particular users.

The objective of the pricing strategy is to contribute to achieving equity and sustainability in water matters by promoting financial sustainability and economic efficiency in water use. One objective is to ensure that the real financial costs of managing water resources and supplying water, including the cost of capital, are recovered from users. Provisions are, however, made for a range of subsidies for water users from historically disadvantaged groups to promote equitable access to the use of water resources.

3.4.1.2 The pricing strategy for water use charges

Important Note: *The pricing strategy, which relates to charges for any water use, is established in terms of the process described in section 56 of the Act, and **not** via the NWRS.*

Information on the water pricing strategy is provided in the NWRS so that as complete an account as possible of the Department's approach to water resources management is presented.

One component of the pricing strategy has already been established - see 3.4.1.3 below. In accordance with the Act's requirements for consultation, the Department will invite comments on other components of the pricing strategy as they are developed.

The full pricing strategy will apply to the uses of water described in section 21 of the Act (see Part 2 of this chapter), that is, taking water from a resource, discharging waste into the resource, storing water and other uses such as the recreational use of water. It also addresses the setting of tariffs by the Department and water management institutions established in terms of the Act. It does not deal with treated water supplied in bulk by, for instance, water boards, and distributed to households via water services authorities, as this is dealt with in the Water Services Act, 1997. There is, nevertheless, an explicit requirement in the Act to ensure that the pricing strategy supports the establishment of tariffs for water services in terms of the Water Services Act.

The water uses described in section 21 are very different and require specific approaches to determining charges. The overall pricing strategy will therefore comprise a number of distinct components, as described below, each of which will be established separately and implemented progressively over time.

3.4.1.3 Pricing strategy for abstracting and storing water, and stream flow reduction activities

Important note: *Following public consultation, this component of the pricing strategy has already been established by the publication of Government Notice No. 1353 of 12 November 1999 and is therefore no longer open for comment.*

A consultative review of the pricing strategy began in mid-2004, and will consolidate water use charges for abstracting, storage, stream flow reduction activities and waste discharge.

In this component of the water pricing strategy charges apply to three consumptive uses of water that can be expressed in terms of annual volumes of water used. These are -

- Abstracting (taking) raw water directly from surface and groundwater resources (section 21(a)).
- Storing water (section 21(b)). This refers to the abstraction of water from storage or, in the case of dams constructed to enhance property values or for recreational use, the initial filling and annual refilling^[1].
- Engaging in a stream flow reduction activity (section 21(d)). Thus far only the use of land for afforestation that has been established for commercial purposes has been declared to be a stream flow reduction activity. Other land-based activities are being considered and may, after public consultation, be declared in future in terms of section 36.

3.4.1.4 Charges for waste discharge

This component of the pricing strategy is currently being developed. It will deal with charges for all aspects of waste discharge, as follows -

- Engaging in a controlled activity (section 21(e) – section 37(1)(a) and (d) also refer).
- Discharging waste or water containing waste into a water resource (section 21(f)).
- Disposing of waste in a manner which may detrimentally impact on a water resource (section 21(g)).
- Disposing of water which contains waste from any industrial or power generating process (section 21(h)).
- Aspects of removing, discharging or disposing of water found underground (section 21(j)) where this has an impact on water quality.

The charging system will be based on the polluter pays principle and will address point and diffuse sources of pollution. It will supplement the more traditional regulatory approach to water quality management, in which standards and objectives are set and enforced by introducing financial and economic incentives and disincentives to –

- ensure that the costs of polluting activities are, as far as possible, borne by the polluter (internalised) and not passed on (externalised) to other water users who could be disadvantaged by the detrimental impacts of waste on water resources, or to the environment;
- encourage the minimisation of waste discharge; and
- promote sustainable, efficient and effective water use.

Charges made under the system are intended to reflect and recover from users the direct and indirect costs associated with the discharge or disposal of waste. It is likely that key representative pollutants and the costs for reducing the impacts of various categories of

pollutants will be identified and methods for determining the direct costs of impacts will be developed.

The structure of tariffs currently being considered includes -:

- A basic charge per volume of water discharged, independent of the concentration of pollutants in the discharge.
- A load-based charge proportional to the waste load, where waste load is the product of the volume of the discharge and the concentration of pollutants. Initially this charge will relate to salinity, nitrogen compounds (ammonia, nitrates and nitrites) and phosphorous.
- Charges in cases where waste loads exceed the maximum permissible levels of pollutants for the resource in question. The charges are intended to encourage self-monitoring and accurate reporting of waste loads, and reduction in waste loads.
- Incentives (rebates) for returning water to the resource of a better quality than was originally abstracted

Tariff structures will be subject to ministerial approval

Revenues from the charges will be used to fund water quality management activities related to waste discharge or disposal, such as impact monitoring and mitigation, the provision of assistance to users to reduce the impacts of their discharges or disposal activities or as subsidies to downstream users to deal with discharges from upstream if this is more effective, as well as rehabilitation of degraded areas, dealing with the effects of spills, and system management and administration.

The proposed system is the subject of detailed consultation with stakeholders. It is anticipated that it will be established in terms of section 56 of the Act in 2006.

The system will be designed to ensure that there is no duplication of charges between charges for waste discharge and water use charges for funding water resource management (see below).

3.4.1.5 Other components of the pricing strategy

The Department is considering the necessity for and practicality of introducing further components of the pricing strategy for impeding or diverting flow in a watercourse (section 21(c)), altering the physical characteristics of a watercourse (section 21(i)) and the use of water for recreational purposes (section 21(k)). Any proposals will be published for comment in terms of section 56.

3.4.2 WATER USE CHARGES

3.4.2.1 Water user sectors

All charges will be specific to each of four end-user sectors, namely -

- Municipal (water services authorities).
- Industry, mining and energy.
- Agriculture.
- Stream flow reduction activities.

Charges may be different for each user sector, depending on the costs of and benefits from water resource management services, or from the use of a particular supply scheme.

3.4.2.2 Setting charges, collecting and disbursing revenue

Catchment management agencies will be established in each of the 19 water management areas (see Part 5 of this chapter). Each agency will be progressively empowered to undertake

water resource management responsibilities, including the setting of charges and the collection of revenue for water use in its area of jurisdiction. Depending on the socio-economic circumstances and physical and demographic characteristics and attributes of each area, charges may differ between water management areas.

However, until catchment management agencies are established, the Department will continue to determine charges and collect revenue. When the agencies are established, the Department will work with them to set charges. In respect of charges for water resource management activities, which are intended to fund the agencies, the Department will ensure that revenue is divided in such a way as to meet the needs of the agencies and the Department as far as possible.

After budgets have been prepared and proposed charges determined, consultations will be held with key stakeholders and the charges announced and made known to users prior to the start of the financial year in which the charges are to be imposed.

3.4.2.3 Charges for funding water resource management

The charges will be based on the budgeted^[2] annual costs that include the following activities, which will eventually become the responsibility of catchment management agencies -

- The planning and implementation of catchment management strategies.
- The monitoring and assessment of water resource availability and use, and resource quality.
- The management of water allocation and utilisation.
- Water quality management, including waste control and pollution control in respect of mines, industries, agriculture and dense settlements. Charges will not include costs related to waste discharge, or the capital costs of abandoned mine rehabilitation, until a waste discharge charge system is implemented.
- Dam safety control.
- Water conservation and demand management, including the control of invasive alien vegetation, education and awareness creation by the Water Education Programme, and control of aquatic weeds where these activities are included in the catchment management strategy. Costs related to poverty relief activities, which do not directly contribute to improving water availability, are excluded from the charge.

3.4.2.4 Application of water resource management charges

Water resource management charges relate to all water used or intercepted by stream flow reduction activities within the water management area, irrespective of whether water is taken direct from the resource or supplied from a government or water management institution scheme. Charges will be imposed in a water management area only when the majority of water use is either licensed or registered.

Unit charges (cents per cubic metre) for each sector will be determined for each user sector and water management area. For billing purposes these unit charges will be applied to the annual water use registered by or licensed to each user. Volumes are based on estimated long-term average annual use (or reduction in runoff in respect of stream flow reduction activities), thereby taking assurance of supply into account. Charges will be based on recovering the costs of managing the total volume of water that may be allocated for use in each water management area. This is determined by deducting the requirements of the Reserve, water required to meet international obligations, water required for use by downstream water management areas, and any water specifically reserved for transfer via new water works to neighbouring areas from the total volume of water available in the area (see Chapter 2 and Appendix D).

Some aspects of the charges will apply to user sectors in different ways, as follows -

- Because there is no requirement for water use to be registered in terms of Schedule 1, such use will not be charged for.
- The municipal sector attracts all charges relating to water resource management.

Important Note: *The Pricing Strategy for Raw Water Use Charges provides for that portion of a municipality's annual raw water demand that comprises the basic human needs component of the Reserve to be free of charge. However, since the Pricing Strategy for Raw Water Use Charges was established, government has indicated that equitable share grants, made to municipalities in terms of the annually-enacted Division of Revenue Act, should enable water services authorities to fund the provision of free basic water. The subsidisation of raw water for domestic use in terms of the pricing strategy, described above, will therefore not be implemented.*

- The industrial, mining and energy sector attracts all charges relating to water resource management.
- The commercial agricultural sector will normally attract all charges after the phasing-in period has come to an end.
- Charges for emerging farmers^[3] using water from government water schemes will be subsidised for five years at a progressively decreasing rate.
- The stream flow reduction activity sector attracts all water management activity costs *except* those related to dam safety control. Where costs are incurred for the removal of invasive alien vegetation in terms of catchment management strategies these will not apply to the forestry sector. Charges for 2002/2003 for the forestry sector were capped at a maximum of R 10 per hectare per annum, and annual increases thereafter will be restricted to the producer price index. The Department is investigating the possibility of limited period subsidies for small-scale emerging tree growers.

In water management areas where there is an over-allocation, that is total registered use exceeds the total water available for allocation, charges for each sector will be based on the registered sectoral use.

Box 3.4.1 Water use charges and inter-catchment transfers of water

Transfer of water from one water management area to another will result in a reduced quantity of water on which charges can be made in the source area and a corresponding increase in the receiving area. Some of the charges raised in the receiving area from those user sectors that benefit from the transferred water will revert to the source area for water resource management purposes. The Department has determined a framework for the calculation and disbursement of the relevant amounts. The percentage of the water resources management budget of the source area to be borne by the receiving area will be determined by the ratio of yield^[4] transferred to total local yield in the source area. The funds transferred between water management areas will be audited by the Department.

This arrangement refers only to engineered transfers of water such as from the Thukela River into the Vaal River system, and not to those that occur naturally such as between the Upper and Lower Vaal water management areas.

3.4.2.5 Charges for funding water resource development and the use of waterworks

Specific charges will be imposed on users of water from government water schemes and systems, and from schemes funded by other water management institutions such as catchment management agencies and water user associations to cover the costs of such schemes. Charges will be based on volumes of water used, and fixed and/or variable charges may be implemented.

(i) Government water schemes

- **Water resource development charges**

In accordance with generally accepted accounting procedures, charges for water resource development on government water schemes will be based on the rate-of-return-on-assets approach, with allowance being made for the depreciation of asset value. A return on assets will ensure efficient use of capital and generate funding for new developments, whilst asset depreciation will fund the refurbishment of infrastructure at the end of its useful life. Capital cost charges on government water schemes will consist of two components. First, a charge based on a four per cent return on the depreciated replacement value of assets and, second, a charge based on the annual depreciation cost.

The depreciable portion of the value of infrastructure on government water schemes will be depreciated in a straight line over the asset's remaining economic life. For the purposes of initial price setting the replacement values, depreciable portions and useful lives of assets have been determined by means of an assets inventory undertaken by the Department. Full technical revaluation of assets will be undertaken at intervals not exceeding 10 years. Desktop revaluation will be undertaken annually by applying the producer price index to asset values and adjusting the depreciation amount. The relevant charges will be adjusted accordingly.

On multipurpose government water schemes, capital costs will be divided between sectors on the basis of water allocations. Charges may be different for different sectors depending on the assurance of supply required (in respect of the use of water from storage), or on peak demand rates (in respect of water received from conveyance structures such as canals and pipelines).

- **Charges for the use of waterworks**

Charges for the use of waterworks are based on the budgeted annual costs^[5] of operating and maintaining the works. Users of water from specific government water schemes pay all the direct scheme-related costs plus an equitable portion of the indirect, non-scheme-specific costs related to managing all the waterworks in the region. The division of costs among sectors is sector-specific, while in the case of under-utilised schemes the cost of joint works is shared in proportion to volumetric use or allocations.

(ii) Waterworks owned and/or managed by other water management institutions

Charges set by catchment management agencies and water user associations in terms of the pricing strategy must be based on the legitimate functions of the institution (initial, delegated and assigned in the case of catchment management agencies and, in the case of water user associations, according to their constitutions). These charges must make provision for the full recovery of capital costs (including the costs of servicing loans), the depreciation of assets, all management, operation and maintenance costs, including associated overheads, and any other charges imposed by law, such as water resource management charges and Water Research Commission levies.

3.4.2.6 Application of water resource development and use of waterworks charges

Charges will be phased in progressively over time, and the target of achieving full cost recovery will therefore be achieved at different times for different sectors, as follows -

- **Municipal sector and Industrial, mining and energy sector:** On government water schemes charges will include depreciation, return on assets^[6], and operations and maintenance. Annual tariff increases will be limited to the producer price index plus 10 per cent until target recovery has been achieved, whereafter increases will be limited to the rate of inflation unless there are new investments or other costs incurred. All costs must be recovered in respect of waterworks owned by other water management institutions.
- **Irrigation sector:** On existing government water schemes charges for commercial farmers include depreciation and the full operating and maintenance cost. Tariff agreements with

commercial farmers came to an end in March 2001, whereafter new agreements were concluded with organised agriculture. A depreciation charge was introduced from April 2001 and will be phased in until the full depreciation cost plus the operating and maintenance costs are fully recovered in terms of the agreements.

- **Emerging farmers:** The operating and maintenance charges for water supplied to emerging farmers from government water schemes will be subsidised on a reducing scale over a five year period. Depreciation charges will be phased in over a further period appropriate to each case until all costs are fully recovered.
- **Stream flow reduction sector:** These charges do not apply to the sector, except in cases where new developments are required, when charges will be negotiated with users.

3.4.2.7 Charges for achieving the equitable and efficient allocation of water

(i) Administratively determined charges, public tender or auction

Once other charges have been fully phased in, economic charges may be determined administratively by basing them on the opportunity cost of water, as reflected in the price paid for water in transactions taking place between users.

In areas where compulsory licensing has been completed, any remaining water may be allocated for use by public tender or auction. Regulations to facilitate this measure will be introduced in due course.

(ii) Water trading

Tradable water use entitlements promote the shift from lower to higher value uses of water, and may obviate the need for the application of administratively determined prices. The Act allows water users to engage in such transactions in terms of a policy developed under section 25 of the Act (see Part 2 of this chapter), subject to the balance being maintained between the general public interest and the interests of water users who wish to trade. The extent of authorised water use, in terms of quantity, quality and assurance of supply, that may be traded across water use sectors is carefully considered and defined before such trading is permitted. Regulations to be introduced in due course will specify the conditions under which trade will be permitted after the compulsory licensing process has been completed. In the interim, applications for trade between user sectors are considered in terms of the provisions of the Act.

3.4.2.8 Application of charges for achieving the equitable and efficient allocation of water

This charge will be determined by the Minister and will be introduced only when the effects of full financial pricing of water on resource use have been evaluated.

3.4.3 FINANCIAL ASSISTANCE

Financial assistance to water users may be provided in two ways, namely -

3.4.3.1 Via the pricing strategy

Current policy is that all charges for water provided from government water schemes to emerging farmers will be subsidised on a reducing scale over a period of five years and depreciation charges phased in over a further period appropriate to each case.

3.4.3.2 Via section 61 of the Act

Capital cost subsidies for the construction or refurbishment of communal waterworks are available to emerging farmers who are members of water user associations. At present the subsidies are limited to the lesser of R10 000 per hectare, R50 000 per person or a person's actual share of the cost of the scheme if it is less than R50 000).

Operational subsidies are available to water user associations that take over the operations and maintenance of government water schemes. The subsidies comprise –

- a once-off subsidy of 50 per cent of the operations budget;
- exemption from payment for depreciation charges in respect of canals; and
- a subsidy to phase in tariffs for emerging farmers over five years.

These policies are currently the subject of an inter-departmental review.

Notes to Chapter 3, Part 4

- ¹ The calculation of the volume of water required for annual refilling will be based on a scientific assessment of losses due to evaporation.
- ² Until catchment management agencies become responsible for these charges, the Department will continue to undertake budgeting and revenue collection by means of the Integrated Catchment Management component of the Water Trading Account created for these purposes.
- ³ An emerging farmer is one who is a member of the historically disadvantaged population groups, and who is regarded as being resource-poor. There is no widely accepted definition of resource-poor, but it could include consideration of factors such as total family income and assets, and participation in land reform and other programmes of corrective action.
- ⁴ The reduction in yield in the source area resulting from the transfer is not necessarily equal to the increase in yield in the receiving area, and neither are equal to the physical volume of water transferred: see box 2.5 for an explanation of why this is so.
- ⁵ Until the management of assets is transferred to other institutions, the Department will continue to undertake budgeting and revenue collection by means of the Bulk Water Supply and Integrated Systems components of the Water Trading Account created for these purposes.
- ⁶ For government water schemes the portion of the charge relating to return on assets will apply only to the municipal and the industrial, mining and energy sectors as these are the sectors for which the demand for water from government schemes is expected to increase. Historical growth rates in demand in these sectors indicate that an annual average rate of return of four per cent applied to the current depreciated replacement value of water infrastructure will achieve a breakeven return.

CHAPTER 3

PART 5 – WATER MANAGEMENT INSTITUTIONS

(Provisions relating to water management institutions are found in a number of places in the National Water Act, as follows -

General powers and duties of the Minister and Director-General – Chapter 6

Catchment Management Agencies – Chapter 7

Water User Associations – Chapter 8

Advisory Committees – Chapter 9

International water management – Chapter 10

The following Schedules also refer to institutional matters:

Schedule 3: Powers which may be exercised and duties to be performed by catchment management agencies on assignment or delegation

Schedule 4: Management and planning of water management institutions

Schedule 5: Model constitution of water user association

Schedule 6: Water Tribunal

3.5.1 INTRODUCTION

The institutional framework is one of the most important aspects of water resources management since it determines the effectiveness of policy implementation. Institutions are also important because they are the focus for requirements in the National Water Act (the Act) to consult widely with water users and other interested persons before policies relating to the management and use of natural resources are implemented (see Chapter 4).

One of the Act's main objectives is to progressively decentralise the responsibility and authority for water resources management to appropriate regional and local institutions in order, among other things, to enable water users and other stakeholders to participate more effectively in the management of water resources. Some of these institutions will have to be created, whilst some of the existing institutions – including the Department – will have to be changed to reflect new or changed responsibilities in terms of the new approach embodied in the Act.

The importance of creating and sustaining an effective institutional framework is reflected in the large body of documentation that has been developed to describe the establishment and operation of water management institutions.

The Act provides for a fundamental transformation of water resources management. The requirement for transformation, especially with regard to service delivery and representivity, extends to all existing water management institutions, while new institutions must be created with these imperatives firmly in mind. The Act requires, in section 2, that all institutions must have "appropriate community, racial and gender representation" and the Department will see to it that this requirement is extended to include representivity in respect of disability. In addition, in accordance with generally applicable policies and laws, all institutions must adhere to acceptable recruitment, employment, procurement, administration and financial management practices.

3.5.2 THE INSTITUTIONAL FRAMEWORK FOR WATER MANAGEMENT

3.5.2.1 The Minister of Water Affairs and Forestry

The Minister of Water Affairs and Forestry (the Minister), as the public trustee of water resources on behalf of the national government, has overall responsibility for all aspects of water resources

management in South Africa. All water management institutions are subject to the Minister's authority.

For practical reasons the Act allows the Minister to delegate most of her or his powers and duties to departmental officials or office holders, water management institutions as they progressively build their capacity, advisory committees and water boards. Four of the minister's responsibilities may not be delegated^[1]. The Minister may also assign^[2] powers and duties to catchment management agencies.

The Minister will, however, retain the responsibility for -

- Determining the class of water resources in accordance with the prescribed classification system, and determining the Reserve in accordance with the class.
- Specifying water requirements for international rights and obligations.
- Specifying a "contingency" to meet projected future water needs.
- Authorising any transfers of water between water management areas.
- Authorising other water uses of strategic importance.

The first four of the above responsibilities relate to the Minister's authority, in terms of section 23, to determine the quantity of water in respect of which a responsible authority may issue a general authority or licence to use water in each water management area. See Part 2 of this chapter for the definition of water use of strategic importance.

3.5.2.2 The Department of Water Affairs and Forestry

At present the Department is responsible for administering all aspects of the Act on behalf of the Minister. The Department is responsible for the development and implementation of strategies and internal policies, plans and procedures, and regulatory instruments relating to the Act. It is also responsible for planning, developing, operating and maintaining State-owned water resources management infrastructure, and for overseeing the activities of all water management institutions.

The Department's role will, however, progressively change as regional and local water management institutions are established and the responsibility and authority for water resources management are delegated and assigned to them. The Department's eventual role will mainly be to provide the national policy and regulatory framework within which other institutions will directly manage water resources, and to maintain general oversight of the activities and performance of these institutions. The Department will continue to manage South Africa's international relationships and activities in water matters, although some aspects of this may eventually also be handled through institutions established with neighbouring countries.

The Department's organisational structure will also continue to change in accordance with its new role and functions under the Act, and to facilitate the development of well-defined relationships with other water-related institutions. The following principles and approaches are guiding the transformation process -

- The Department will progressively adjust its role in water resources management to concentrate on policy and strategy issues, overall regulatory oversight, and institutional support, co-ordination and auditing. Its Regional Offices are currently responsible for direct service provision and their transformation will be particularly profound.
- The Department may progressively withdraw from direct involvement in the development, financing, operation and maintenance of water resources infrastructure as this is at odds with the regulatory role. Alternatively, if the Department retains the development function, this role will be clearly separated from its policy and regulatory functions. The question of which institution(s) should be responsible for infrastructure development and operation is still under discussion, and is discussed below.

- The Department will transfer the responsibility for operating and maintaining some infrastructure to water management institutions and water services institutions, but catchment management agencies may take on these responsibilities only if their regulatory role is not prejudiced.
- The establishment, capacitation and empowerment of catchment management agencies for all water management areas should proceed as rapidly as possible. The transitional period during which an agency and the relevant Regional Office are jointly responsible for water resources management must be carefully managed to reduce uncertainties around the division of functional responsibilities and accountability. Once the governing board is in place, ideally no more than five years should elapse until the agency is able to take on the duties of a responsible authority (see below). However, the pace of the process must take account of the limitations of financial and human resources, the necessity for a process in which all interested parties may participate and the time needed to build the capabilities of the agencies.

The new organisational design for the management of water resources in the Department was finalised early in 2003 and details have been publicised. Time scales for the implementation of the new organisational structure will be co-ordinated with the closely related process of establishing and empowering catchment management agencies.

3.5.2.3 Water management institutions and responsible authorities

Section 1(1)(xxvi) of the Act defines a water management institution as a catchment management agency, a water user association, a body responsible for international water management, or any person who fulfils the functions of a water management institution in terms of the Act.

The powers and duties of a water management institution relate to water resources management in general. The Act also defines a responsible authority, whose duties relate specifically to water use (section 1(xx)) and particularly to the authorisation of water use by general authorisation or licence. The Act's provisions for authorisation of water use make it clear that only the Minister, or a catchment management agency to which the appropriate powers and duties have been assigned may authorise the use of water. Other water management institutions may not authorise water use.

There are, however, limits to a catchment management agency's power to authorise water use. The Minister retains responsibility for authorising certain uses at national level (see 3.5.2.1 above) and a catchment management agency may not issue a licence to itself without the Minister's consent (section 27).

3.5.2.4 Water management areas

After a countrywide process of public consultation, 19 water management areas covering the entire country were established in October 1999 by Government Notice No. 1160. The boundaries of the water management areas (that is, those boundaries that are not defined by international boundaries or South Africa's coastline) lie mostly along the divides between surface water catchments^[3] and are shown on Fig. 3.5.1.

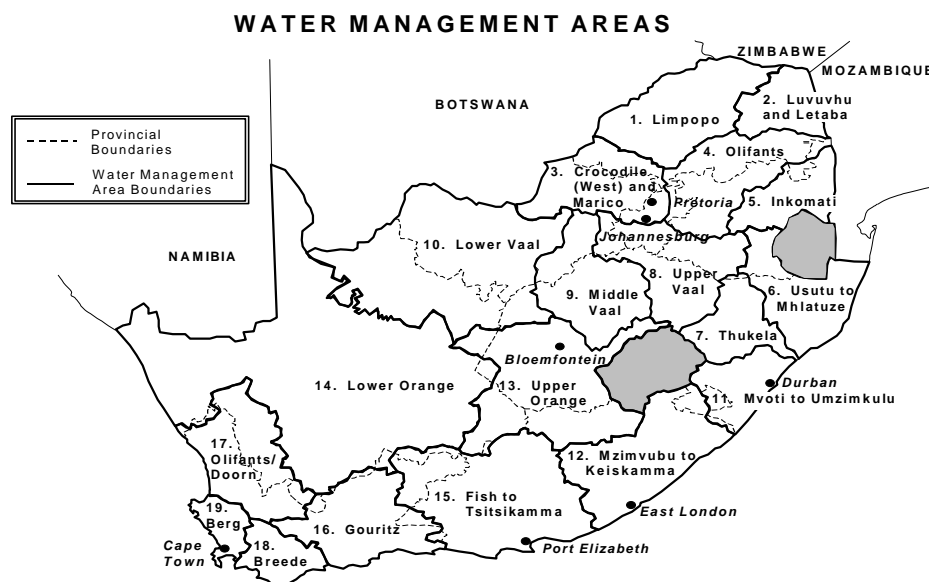
The number of water management areas and the location of their boundaries were determined by considering factors such as -

- the institutional efficiency of creating a large number of catchment management agencies, each managing a relatively small area, compared with a small number of agencies, each managing a larger area;
- the potential for a catchment management agency to become financially self-sufficient from water use charges;
- the location of centres of economic activity;
- social development patterns;

- the location of centres of water-related expertise from which the agency may source assistance; and
- the distribution of water resources infrastructure.

The boundaries of the water management areas are described in Appendix E. It is important to note that the boundaries, firstly, do not coincide with the administrative boundaries that define the areas of jurisdiction of provincial and local government authorities. Secondly, the boundaries are not irrevocably fixed for all time, and can be changed if necessary as management experience and understanding of hydrologic systems grows, to achieve greater efficiency or effectiveness. Operational experience and interactions with water users and other stakeholders since the water management area boundaries were established in 1999 have indicated that minor amendments to the Gazetted boundaries will have benefits in terms of water resources management in general, and for billing for water use charges in particular. The proposed amendments address cases where, for instance, the area covered by a water user association, a groundwater aquifer or even an individual farm falls into two water management areas and where, without the amendments, charges would eventually be payable to two catchment management agencies. The amendments, which will be established when the NWRS is established, are not evident from the figure but they are described in detail in Appendix E.

Fig. 3.5.1: Water management areas (numbered 1 to 19)



3.5.2.5 Catchment management agencies

Catchment management agencies are statutory bodies that will be established by Government Notice. They will have jurisdiction in defined water management areas, and will manage water resources and co-ordinate the water-related activities of water users and other water management institutions within their areas of jurisdiction. An agency begins to be functional once a governing board has been appointed by the Minister (see also Advisory Committees below) and is then responsible for the initial functions described in section 80 of the Act^[4], as well as any other functions delegated or assigned to it. The governing board must represent all relevant interests in the water management area and must have appropriate community, racial and gender representation.

The initial functions of the agencies include the important responsibility of developing a catchment management strategy. This strategy, which may not be in conflict with the National Water Resource Strategy (NWRS) and must give effect to its provisions and requirements,

provides the framework for managing the water resources of the area. In particular, it must determine the principles according to which available water will be allocated among competing user groups.

Additional functions may be delegated or assigned to an agency or establishment according to a strategy described in the proposal for establishment (see below), which addresses the resources required to undertake the additional functions. After its establishment, the agency may acquire further powers and duties following consultation with the Minister, who must be satisfied that the agency has developed the necessary capacity to undertake the additional functions.

The delegation and assignment of duties and responsibilities will include the financial and administrative responsibilities of setting and collecting water use charges, the technical water resources management functions based on the issues identified in the catchment management strategy, and the responsible authority functions relating to the authorisation of water use. The timing of the delegations and assignments will depend on the capacity of the agency to undertake the functions.

An agency may, with the Minister's written consent, delegate powers to another statutory body, but it may not delegate the power to delegate, and the power to authorise water use may be delegated only to a committee established by the governing board on which a minimum of three board members serve. Agencies may contract public water management institutions or private sector organisations to carry out specified activities, but preference must be given to local organisations, taking into account their capacity and representivity, and efficiency, quality, time and cost considerations.

Each water management area is different, with different requirements for water resource management, and the Act gives the governing board considerable flexibility in the approach it adopts to carrying out its duties, for instance -

- The board may appoint a suitably qualified chief executive officer and appropriate supporting staff. It may choose to appoint a relatively large staff complement, enabling it to carry out all of its functions in-house, or it may appoint fewer staff members and engage contractors for specific tasks.
- The board may establish committees, to which it may delegate its powers and duties, to carry out any of its functions either for the whole water management area, or in specific sub-areas.
- An agency may contract another catchment management agency to perform some of its functions, but only if the contracted agency has the capacity to provide external services without prejudicing its ability to undertake its responsibilities in its own area. Such arrangements must, however, not be to the detriment of other water management institutions.

In areas where agencies have not yet been established, or where they are not yet fully functional, all powers and duties vest in the Minister, and the Department will undertake the agencies' functions on the Minister's behalf (section 72).

Catchment management agencies may be established either on the Minister's initiative, or as a result of a proposal, submitted to and approved by the Minister, by those wishing to establish the agency. The proposal must include, among other information, details of the boundaries within which the proposed agency will operate, information about the water resources and existing infrastructure in the area and the ways in which they are managed. However, the Minister's intention to establish 19 agencies was indicated when the water management areas were defined and established. (The water situation assessments described in Chapter 2 and Appendix D have been carried out based on these boundaries). Accordingly, the Department is taking the lead in the establishment process and, in most cases, providing the bulk of the funding for it. The process will, however, also involve the submission of a proposal to the Minister, which will be prepared through a process of public participation that will involve water user sectors and stakeholders.

Public involvement in this process is essential, because it contributes to establishing the legitimacy of the institution, assists the advisory committee in making nominations to the Minister for the governing board by identifying representative stakeholder groups, and builds a foundation for the agency to promote public involvement in water resource management. Accordingly, the extent to which stakeholders have been involved in the development of a proposal to establish an agency is one of the most important criteria against which the Minister will judge the merit of the proposal.

Stakeholder participation can be initiated by distributing information to create awareness. The establishment of representative forums helps to develop constructive and trusting relationships between water resource managers and the public, with the aim of forming a common vision and understanding of the future agency's role and functions. The relationship can be strengthened by involving the forums in progressing the development of a proposal to the Minister by, for instance, assisting with the compilation of the required water resources information and participating in the investigation to determine the financial viability of the agency. This study comprises an assessment of the functions to be undertaken by the agency and the level of staffing required to undertake them, from which the agency's operational and staff costs can be derived. Comparing these costs with the anticipated revenue from water resource management charges, determined in accordance with the pricing strategy (see Part 4 of this chapter), enables the likelihood of the agency becoming financially self-sufficient to be determined.

Ministerial approval of the proposal will pave the way for the appointment of the governing board and for the board to appoint the necessary staffing structure.

Establishment and full empowerment of catchment management agencies in all water management areas will take some time to achieve. In the meantime the Department will manage the areas on the Minister's behalf.

The Department will provide support for the agencies, initially during their development, and subsequently when they are fully established. During the transition period between the establishment of the agencies and their empowerment as responsible authorities, the Department and the agencies will work closely together. The respective roles will change as powers and duties are delegated and assigned to the agencies and it will be essential for roles and functions to be clearly defined at each stage of the transition. Eventually the Department will be responsible only for ongoing oversight and general support of the agencies.

3.5.2.6 Water user associations

Water user associations are also defined in the Act as water management institutions, but the scope of their objectives and their geographical extent are more restricted than those of catchment management agencies. They are in effect co-operative associations of individual water users who wish to undertake water-related activities at a local level for their mutual benefit, and they operate in terms of a formal constitution as set out in guidelines prepared by the Department. The associations are expected to be financially self-supporting from income derived from water use charges determined and made in terms of the pricing strategy and payable by members.

A water user association falls under the authority of the catchment management agency in whose area of jurisdiction it operates to the extent that the agency has received delegated powers from the Minister to direct the association's activities. An association may receive delegated powers and duties from, or be contracted by, the catchment management agency to undertake activities that are within its capacity to perform. The scope of the association's constitution must, if necessary, be amended to reflect the delegated or contracted activities.

Existing irrigation boards, subterranean water control boards and water boards established for stock watering purposes^[5] in terms of the 1956 Water Act must be transformed to become water user associations, or be disestablished in terms of the law under which they were established. A

proposal to transform an existing body to a water user association, which should be developed in consultation with individuals and organisations likely to be affected, must be submitted to the Minister. The proposal must contain, among other things, information about the proposed activities and the area in which they will be undertaken, a proposed constitution and details of proposed members of the association. Almost 300 existing organisations are to be transformed into water user associations^[6] and the intention is to complete this process by the end of 2006. In some cases the management responsibilities may be extended to include all water uses, resulting in multi-sector water user associations.

New water user associations may be established for any purpose, such as, for example, the use of water for recreational purposes. Local management by water user associations may also be appropriate in areas where there is extensive reliance on groundwater, especially where the systems are stressed. It is, however, expected that the majority of associations will continue to focus on the use of water for agricultural purposes. The Department will support the establishment of new associations to build the capacity of emerging farmers in this sector, which will permit them to access subsidies in terms of the pricing strategy.

New associations may be established on the Minister's initiative or, as a result of a proposal submitted to the Minister, by parties interested in establishing the association. A submission to establish a new association must be identical in content to that required for the transformation of irrigation boards discussed above. Whichever establishment route is followed, the Minister must ensure that a public consultation process (see Chapter 4) is undertaken before the association is established. The Department will provide special support and facilitation where new water user associations are being established for previously disadvantaged groups.

3.5.2.7 Advisory committees

The Act empowers the Minister to establish advisory committees with different purposes and functions. Although primarily advisory in nature, such committees may also exercise any powers the Minister delegates to them. Advisory committees are responsible to the Minister, who may make regulations concerning their terms of reference, membership, powers, duties and operation.

The National Water Advisory Council, the Advisory Committee on Safety of Dams and any advisory committee established under section 68(1) of the 1956 Water Act are regarded as advisory committees in terms of the Act.

Although in most cases the establishment of an advisory committee is at the Minister's discretion the Act obliges the Minister to establish an advisory committee to make recommendations on the composition of the governing board of a catchment management agency. The advisory committee must consult widely in the water management area to ensure that its nominations represent all relevant interests. The Minister must have good reason not to appoint the members nominated by the advisory committee, but the Minister may appoint additional members to ensure both full representation and the availability of sufficient expertise on the board for it to carry out its duties.

3.5.2.8 Forums

There is no specific provision in the National Water Policy or the Act for creating forums for water resource management purposes. However, in the Department's experience such voluntary bodies have proved to be of great value in initiatives leading to the creation of catchment management agencies, and in addressing local water management issues. They have provided a focus for public consultation and for integrating the water-related activities of other non-governmental and community-based organisations. There is, however, a need to establish co-ordination mechanisms in each water management area to ensure that there is clarity of functions among the various forums and that issues of local concern are effectively and coherently communicated to the catchment management agency. Meaningful local participation in water matters must also be facilitated.

In the past, forums have also made significant contributions to water resources management at a local level by, among other things, providing essential local knowledge, expertise and information. In this respect they may eventually be expected to play an important role in the operation of catchment management agencies. Examples for such a role already exist in the multi-sector forums that have been established in the four provinces where there is extensive commercial afforestation to review applications for the establishment of commercial plantations. The Department will continue to support existing forums and encourage the creation of new ones where the need arises.

3.5.2.9 Institutions for infrastructure development and management

The Department has developed and owns, operates and maintains a number of water resources schemes comprising dams and related infrastructure such as pumping stations, pipelines, tunnels and canals. The schemes vary greatly in size. The infrastructure has an estimated (March 2001) replacement value of some R38 000 million and occupies some 2 500 departmental staff in its management.

The Department has developed and maintained considerable specialist design and construction capacity, which is of strategic importance given the high level of specialist expertise required for such activities and the limited alternative sources.

The responsibility for operating and maintaining schemes that are of local importance, or mainly serve one user sector, such as agriculture or a single municipality, are being transferred to the appropriate water user associations and water services institutions. Subject to the agreement of National Treasury, the schemes may eventually be transferred into the ownership of the operating institution.

This will, however, not be the case for schemes that are of wider importance because they transfer water across national boundaries or between water management areas, serve multiple user sectors or large geographic areas, comprise several interconnected catchments, or serve a strategic purpose, such as the generation of electricity for the national grid. Examples are large systems such as the Vaal, Umgeni, Amatole and Riviersonderend-Berg River systems, major water transfer schemes such as Thukela-Vaal and Orange-Fish, and major dams such as Gariep and Van der Kloof. These schemes are regarded as national water resources infrastructure. In consultation with other role players - the National Treasury, the Public Service Commission, the Department of Public Enterprises, the Ministry of Transport, Eskom, the South African Association of Water Utilities, The Department of Provincial and local Government, the South African Local Government Association and organised labour (NEHAWU and the PSA) - an investigation has been undertaken to determine the most appropriate institutional arrangement for their development and management.

Two options have been investigated, namely -

- The Department separates, or "ring fences", the development and management of national infrastructure from its other activities and creates a separate and distinct organisational entity within the Department. The disadvantage of this option is that the Department has no powers to borrow money, and may finance its infrastructure-related activities only from allocations from the National Treasury or through special purpose vehicles established for the purpose.
- The establishment of a new national organisation, or a small number of sub-national organisations - a national water resources infrastructure agency or regional agencies - to manage national infrastructure and to develop new infrastructure as required. This option is in accordance with the trend towards executing the State's role in direct service provision through appropriately structured public organisations. This would also have the advantage of providing greater flexibility in the financing of infrastructure development projects. It is important to note that as such an agency (or agencies) would be a public entity, its establishment would not constitute the privatisation of state-owned infrastructure. An agency

(or agencies) of this nature could possibly be contracted to develop and operate infrastructure required by catchment management agencies or water user associations.

Of the above alternatives, the preferred option is to establish a single agency with four regional operating units. A business case will be prepared for the agency, which will be evaluated by the Ministries of Finance, and Public service and Administration and, if the establishment of the agency is supported, the proposal will be submitted to Cabinet in 2004.

The Act empowers the Minister to direct the Trans-Caledon Tunnel Authority (see below) to undertake specific activities related to its core business of financing major water infrastructure. In this context the Authority is already supporting Umgeni Water's treasury and is leading the implementation of the Berg Water Project in the Western Cape.

3.5.2.10 Institutions for international water management

Internationally shared river basins comprise about 60 per cent of South Africa's land surface. The Act, together with the Revised Protocol on Shared Watercourses in the Southern African Development Community, commits South Africa to sharing water in international river basins with neighbouring countries in an equitable and reasonable manner. Accordingly, the Minister may, in consultation with the Cabinet, establish institutions to implement international agreements in respect of the development and management of shared water resources and to pursue regional co-operation in water matters.

Three existing bodies, the Trans-Caledon Tunnel Authority (RSA portion of the Lesotho Highlands Water Project), the Komati Basin Water Authority (RSA-Swaziland), and the Vioolsdrift Noordoewer Joint Irrigation Authority (RSA-Namibia), are regarded as international water management bodies in terms of the Act. The roles of the Trans-Caledon Tunnel Authority and the Komati Basin Water Authority in funding infrastructure development are discussed in Part 9 of this chapter.

Although not established in terms of the Act, the following international structures have been established to further the development and management of the four international river basins that South Africa shares with neighbouring countries -

- Lesotho Highlands Water Commission (LHWC) (Lesotho, RSA).
- Swaziland/RSA Joint Water Commission.

These were originally project-related and focused on the Lesotho Highlands Water Project and the Komati River Development Project respectively, but both now deal with other matters of common interest.

- Orange/Senqu River Basin Commission (Botswana, Lesotho, Namibia and RSA).
- Limpopo Basin Permanent Technical Committee (LBPTC) (Botswana, Mozambique, RSA and Zimbabwe).

The former is a river basin commission in terms of the Revised Protocol on Shared Watercourses in the Southern African Development Community. The Agreement to establish the Limpopo Watercourse Commission was signed in Maputo in November 2003. This will replace the LBPTC^[7].

- Botswana/RSA Joint Permanent Technical Water Committee.
- Mozambique/RSA Joint Water Commission.
- Permanent Water Commission (PWC) (Namibia, RSA).
- Swaziland/Mozambique/RSA Tripartite Permanent Technical Committee (TPTC).

These deal with matters of common interest.

River basin commissions

The role of the river basin commissions is to foster sustained dialogue between countries, leading to cohesive and effective co-operative management and optimal utilisation of shared resources. They will provide focal points for the joint formulation of development plans for the basin, co-ordination of joint basin studies, and collection and sharing of information.

The commissions are not water management institutions in terms of the Act, and the responsibility for implementing jointly developed projects will normally remain with the domestic institutions. The commissions will, however, have an important role to play in promoting the implementation of regional projects.

International co-operation in water matters is discussed further in Chapter 5.

3.5.2.11 Monitoring institutional performance

The Act provides for various formal instruments by which the performance of institutions may be monitored and assessed, as follows:

- **Catchment management agencies and water user associations** are required to prepare business plans and annual reports. The first business plan must be for a period of not less than three years. Thereafter the business plan must be updated every year. It must at least cover the objectives of the institution, its strategies and policies, services to be provided and service standards, financial and performance indicators and targets, details of financial strategies, and revenue and expenditure forecasts. A copy of the plan must be provided to the Minister who may, after consultation with the relevant agency or association, direct that changes be made to the plan.

Catchment management agencies and water user associations will have to comply with the general requirements for public finance management. Specific requirements are also contained in the Act. These include that the annual reports of institutions must contain details of their operations and financial statements, and that the report must be submitted to the Minister and be made available to the public for inspection or purchase. A catchment management agency's annual report must be tabled in Parliament, whilst that of a water user association must be copied to the Secretary to Parliament.

- **An institution for international water management** established in terms of the Act is required, unless the particular international agreement provides otherwise, to submit a report each year to the Minister and any other party specified in the international agreement. The report must contain sufficient details to enable the Minister to assess the institution's performance against the objectives of the agreement, as well as audited financial statements for the financial year. The report must be submitted to the Secretary to Parliament via the Department

3.5.2.12 The Water Tribunal

The Water Tribunal was established when the Act was promulgated in October 1998. It replaces the Water Court, which ceased to exist when the 1956 Water Act, in terms of which it functioned, was repealed.

It is not a water management institution in terms of the Act, but an independent body with a mandate to hear and adjudicate appeals on a wide range of water-related issues^[8], mainly against administrative decisions made by responsible authorities and water management institutions. It will also adjudicate claims for compensation where a user considers that the economic viability of her or his water-use activity has been severely prejudiced by a refusal to grant a licence, or a reduction in water use when a licence is granted or reviewed. However, some alleged breaches of administrative procedures will be adjudicated by the courts in terms of the Promotion of Administrative Justice Act (also see Chapter 5). The Tribunal has jurisdiction everywhere in the country and it may hold hearings in the areas where the cause of action arose. Its operations are funded from the National Treasury.

Procedural rules for the Tribunal are in preparation and will be published in the *Government Gazette* when they have been approved by the Minister. Appeals are being dealt with relatively quickly and inexpensively. It is not, for instance, necessary for a person making an appeal to the Tribunal to have legal representation. The Tribunal can subpoena any person to provide information on any matter before it. Records of its decisions will be made available on request. A person who is not satisfied with the Tribunal's decision may, on a question of law, appeal against the decision to a High Court.

The Minister, after receiving nominations from the Judicial Services Commission (in respect of persons qualified in law) and the Water Research Commission (in respect of persons qualified in water resources management, engineering and related fields of expertise), appointed the first members of the Tribunal in May 2001. Members of the Tribunal serve a three-year term, after which they may be re-appointed.

3.5.3 RELATIONSHIPS AMONG WATER MANAGEMENT INSTITUTIONS

The institutional relationships based on statutory authority are explicit in the Act. The Minister has overall authority over all water management institutions, which gives her or him the following powers:

- The Minister empowers institutions, including the Department, by delegating (and, in the case of catchment management agencies, assigning) powers and duties to them.
- The Minister has general oversight of the plans and performance of institutions through the requirement for them to submit business plans, financial strategies and targets, and annual reports for approval.
- The Minister may exercise control over institutions by issuing directives to them on a wide range of matters concerning their performance in exercising any of their duties or powers, including those that have been delegated or assigned to them.

In addition, catchment management agencies may, when empowered to do so, delegate powers and duties to their own committees and to water user associations.

However, the vertical, hierarchical relationships defined in the Act are not sufficient to ensure that the institutions will operate successfully, as this will depend heavily on all institutions building co-operative and supportive working relationships with each other.

This is particularly the case for catchment management agencies, which, as the focus for regional water resources management, will need to establish strong relationships with stakeholders, administrative authorities, and other water management and water services institutions, including water user associations since these are not only water users, but also have responsibility to the agencies for water resources management functions exercised under delegated authority. The administrative authorities in question are local and provincial government departments responsible for, amongst others, land and agriculture, environmental management, housing, health, provincial planning and social development. It will also be important for those catchment management agencies that operate in internationally shared river basins to establish working relationships, via the Department, with the river basin commissions.

Local government is a constitutionally distinct sphere of government. Those local authorities that are designated as water services authorities are, either directly or indirectly via water services providers, responsible for the provision of water services^[9] in their areas of jurisdiction and are therefore also water users. This use, including the treatment and disposal of waste water, will eventually be authorised and regulated by the agencies. Relationships between the agencies and local authorities will need to ensure that there is a high degree of integration between water resources management and water services provision.

The relationships between water management institutions and water services institutions are discussed more fully in Chapter 5. The inclusion of local and provincial government representatives on the governing boards of catchment management agencies is intended to facilitate these relationships.

Notes to Chapter 3, Part 5

- ¹ The Minister may not delegate the power to: (i) make a regulation; (ii) authorise a water management institution to expropriate property; (iii) appoint a member of the governing board of a catchment management agency; and (iv) appoint a member of the Water Tribunal (see NWA section 63(2)).
- ² In delegating powers and duties the Minister remains accountable for the consequences of actions carried out under the delegated authority. When powers and duties are assigned to institutions or individuals, the assignee becomes accountable.
- ³ In some flat areas in the north-west and west of the country, where the boundaries of surface water catchments are difficult to determine and where groundwater is the principal source of water, parts of the water management area boundaries are based on aquifer boundaries. In other areas, however, the water management area boundaries cut across the boundaries of groundwater aquifers, the dolomitic aquifer in the North West Province for instance.
- ⁴ The initial functions of catchment management agencies (section 80 of the Act) are to: (a) investigate and advise interested persons on the protection, use, development, conservation, management and control of the water resources in its water management area; (b) develop a catchment management strategy; (c) co-ordinate the related activities of water users and of the water management institutions within its water management area; (d) promote the co-ordination of its implementation with the implementation of any applicable development plan established in terms of the Water Services Act, 1997 (Act No. 108 of 1997); and (e) promote community participation in the protection, use, development, conservation, management and control of the water resources in its water management area.
- ⁵ Stock-watering water boards to be transformed to water user associations are the Kalahari West Water Board, the Karos-Geelkoppen Water Board and the Kalahari East Water Board (see NWA section 98(1)).
- ⁶ At the end of March 2004 51 irrigation boards had been transformed into water user associations, and 237 remained to be transformed. One board had been disestablished, and eight remain to be disestablished.
- ⁷ River basin commissions for the other two internationally shared river basins will be established in due course (see Part 8 of this chapter and Chapter 5).
- ⁸ The matters on which a person may make an appeal to the Water Tribunal are described in section 148 of the Act, which, together with Schedule 5, also outlines the procedure for making an appeal.
- ⁹ Water services means water services provision and sanitation services (see Water Services Act, section 1(xix)).

CHAPTER 3

PART 6 - MONITORING AND INFORMATION

(Provisions for monitoring and information systems for water resources and responsibilities for providing water-related information are found in Chapter 14 of the National Water Act)

3.6.1 INTRODUCTION

The availability of reliable data and information on all aspects of water resources management is fundamental to the successful implementation of strategies under the National Water Act (the Act). No proper decision on any matter can be made unless it is informed by reliable, relevant, up-to-date information.

Information for decision-making should reflect the integrated nature of water resources, in which the quantity and quality of surface and ground water are all inextricably interrelated. For instance, decisions about the licensing of proposed water uses require data and information on, among others: the management class of the resource and the associated Reserve and resource quality objectives; international obligations that have to be satisfied; the quantity of water available in the resource and its quality; the extent and nature of other lawful and authorised uses from the resource; the potential for efficiency gains through managing demand; and the potential for augmenting supply by dam construction. If there are information deficiencies in any of these aspects, the decisions reached will not necessarily be optimal.

To meet the requirement for integrated information the Department is reviewing and, where necessary, revising all data acquisition, monitoring and information arrangements to ensure that all relevant data is collected, verified and stored, and that there is consistency in the data that are common to the various water resources management functions. At the same time, the facility to analyse data and provide information in different ways to meet specific requirements will be retained and improved.

National systems will be designed in such a way that catchment management agencies, once established, will be able to take an appropriate level of responsibility for managing information relevant to their water management areas and, where necessary and feasible, have access to information from adjacent areas with which there are links. Information systems in a water management area will nevertheless remain part of the national system so that information is available at national level.

The national information system for water services, as required by the Water Services Act^[1], will be linked to information systems for water resources.

The Act empowers the Minister to require any person to provide data and information on either an *ad hoc* or a regular basis for the national monitoring and information systems, to facilitate the management and protection of water resources. Regulations may be written in this respect. Water management institutions are also obliged to make information on any water-related matter held in the national systems about which the public needs to know available to the public, particularly if it concerns an actual or potential disaster, or an emergency situation.

3.6.2 MONITORING SYSTEMS

The Act requires the Minister to establish national monitoring systems for water resources to collect appropriate data and information that is necessary to assess -

- the quantity, quality and use of water in water resources;
- the rehabilitation of water resources;

- compliance with resource quality objectives;
- the health of aquatic ecosystems;
- atmospheric conditions that may influence water resources; and
- other data and information that may be necessary.

The Department already operates a number of monitoring systems that collect some of the required data and information. However, the systems were developed and are being operated largely in isolation from one another. Spatial coverage is incomplete and as a result little or no information is collected in some areas. Problems are also being experienced with the quality and reliability of information. The dissemination of and access to information is not as effective or as comprehensive as it might be. Access to relevant data collected by other organisations, including other national government departments, provincial and local governments, water boards, private sector organisations and water users, is problematic in some cases.

The Department is addressing these shortcomings by amalgamating all existing and planned monitoring and assessment systems into a coherent and structured monitoring, assessment and information system. Monitoring systems may be grouped into logical subsystems, each comprising three functional components: data acquisition; data storage, maintenance and dissemination; and data analysis, information generation and reporting.

Improvements in efficiency and effectiveness are expected through sharing logistics and infrastructure in data collection and storage, by adhering to common standards and guidelines, and by refining analytical techniques to maximise the information derived from available data.

An important component of the monitoring and assessment strategy will be to develop co-operative and collaborative relationships between the Department and other organisations that also operate water-related monitoring, assessment and information systems. These include national, provincial and local government, water management and water services institutions, the South African Weather Services, private sector organisations and water users and the aim will be to ensure that appropriate mechanisms and procedures are implemented to co-ordinate the monitoring of water resources.

Brief details of existing monitoring systems and plans to improve and/or extend them to meet the Act's requirements are provided below.

3.6.2.1 Surface water - flow monitoring

Flow in rivers is monitored at 800 national monitoring stations, each of which can be a combination of all or some of the following -:

- A gauging point or points at which river flow is measured directly.
- One or more flood monitoring points.
- Meters measuring flow in reservoir off-takes or outlets.
- A gauging point or points at which reservoir water levels are measured.
- A meteorological station at which rainfall and evaporation are measured.

Data collected at national monitoring points is assessed and interpreted to derive catchment hydrological characteristics, and to obtain customised information for water resource managers and other users.

The present spatial density of national monitoring points - an average of one station per 1 500 square kilometres - is considered to be inadequate for a country that, by international standards, has a relatively low per capita availability of water and that is approaching full utilisation of available water. Based on the best practice standards described in the World Meteorological Organisation's *Guide to Hydrological Practices*, and considering the characteristics and probable requirements in each water management area, the station density should, assuming the continued use of existing monitoring methods and technology, be increased to an average of

one national monitoring point in less than 1 000 square kilometres. To achieve this station density an additional 500 national monitoring points will likely have to be established during the next 20 to 25 years. The number of meteorological stations may also need to be increased from 275 to 350, possibly more if the South African Weather Service decides to reduce its network.

There are also 625 operational flow monitoring sites at reservoirs, in transfer schemes and at major irrigation schemes. Anticipated future operational requirements in the water management areas, including the necessity to establish stations to monitor compliance with Reserve requirements, indicate that the number of operational sites may need to be increased to between 1 500 and 2 000.

The monitoring network is continuously reviewed to ensure optimal coverage for existing and new data needs. The expansion of the monitoring network is a long-term project, which could take between 20 and 25 years to accomplish. In view of the high cost of the expansion (see Part 9 of this chapter) and the requirement for ongoing operation, a review will be undertaken of technological trends in this area to determine if more cost-effective options are available and appropriate.

3.6.2.2 Surface water - water quality monitoring

Various water quality parameters are monitored. These include -

Physico-chemical monitoring: The National Chemical Water Quality Monitoring Network comprises approximately 850 monitoring points in rivers and at reservoirs. Monitoring is undertaken by the Department's regional offices, as well as by water boards and private sector organisations. The size of the network is considered to be adequate.

Microbial monitoring: The National Microbial Monitoring Network is operational in eight water management areas.

Eutrophication monitoring: The National Eutrophication Monitoring Programme, which includes cyanobacterial surveys, is operational in 50 reservoirs.

Biological monitoring: The National River Health Programme, which monitors biological indicators, operates in selected catchments in all 19 water management areas in partnership with the Department of Environmental Affairs and Tourism and the Water Research Commission. The Programme produces State of the Rivers Reports.

Toxicity monitoring: The National Toxicity Monitoring Programme is in its planning and design phase.

Radioactivity: The National Radioactivity Monitoring Programme is being tested in three areas where mining activity takes place.

Estuary monitoring: A National Estuarine Monitoring Programme is planned.

The structure and co-ordination of these programmes will be reviewed as part of the implementation of the overall monitoring, assessment and information system, the various substructures will be prioritised and their implementation and expansion will be programmed in accordance with available resources.

3.6.2.3 Groundwater monitoring

Groundwater was regarded as "private" water under the 1956 Water Act, and as a result its status was not monitored or assessed to the same extent as surface water. However, groundwater has the potential to contribute significantly to meeting the needs for water in rural areas, particularly for domestic supply. Existing monitoring networks will need to be expanded and refined, and surveys undertaken to improve understanding of the quantities and quality of water available if this potential is to be mobilised, and the use of groundwater integrated with surface water use.

Groundwater levels and water quality are currently recorded on a continuous basis at 150 points and at regular intervals at about another 1 000 points. Continuous monitoring at an estimated 460 points is required for an effective national network. The intention is to refine and develop the present system to create an integrated monitoring network at three levels, namely -

- National monitoring by the Department in relatively unimpacted areas to provide background and baseline information on water levels and water quality. The establishment of this part of the network has the highest priority and its expansion is planned for completion by 2006.
- Monitoring of major aquifers by catchment management agencies to determine trends in water levels and water quality resulting from human activity. This will initially only cover physico-chemical monitoring, although the scope will eventually need to be expanded to microbial, toxicity and radioactivity monitoring. The Department will continue with this monitoring until the catchment management agencies can take over the responsibility. Pilot networks have been established in the water management areas that have been prioritised for compulsory licensing under the programme for major activities to implement the Act (see Part 8 of this chapter). This will also inform priorities for the expansion of the network.
- Local impact monitoring. Information provided by users in terms of the conditions attached to general authorisations and licences will be an important source of information on groundwater use. Additional information will be derived from reports on conditions encountered during borehole drilling.

3.6.2.4 Resource requirements for monitoring

The resources that are currently available for monitoring - staff, funding, physical infrastructure, instrumentation and information technology equipment - are generally inadequate throughout all existing systems. The proposed expansion of monitoring activities will require additional resources and the Department is assessing and quantifying the requirement for additional resources as part of its overall implementation planning. The training of water resources management practitioners will also need a significant investment, especially where new technologies are introduced.

3.6.3 INFORMATION SYSTEMS

The Act requires the Minister to establish national information systems, including -

- A hydrological information system.
- A water resource quality information system.
- A groundwater information system.
- A register of water use authorisations.

Brief details of the major existing and new information systems are provided below.

3.6.3.1 Surface water hydrology

The Department's existing mainframe-based Hydrological Information System and a number of peripheral and related systems were replaced with a new system in 2002. The new system is a server-based commercial system that is already in use in several countries. It is user-friendly, has extensive graphics capabilities, supports data analysis, can provide a range of information and makes use of GIS mapping to display systems and networks. It can be used as an independent system by, for instance, hydrological practitioners providing services to water management institutions. It can also be used as an integrated, web-enabled system with inter-connections between the Department and catchment management agencies.

After installation in the Department's National Office in 2002 and following the transfer of data from the existing system and extensive staff training, the new system is expected to be operational in all regional offices by 2004.

3.6.3.2 Water quality

The Department is developing its Water Management System to handle the operational management of water quality monitoring systems and to store, process and disseminate the results. The system facilitates the consolidation of monitoring activities to reduce or eliminate duplication through the auditing of monitoring schedules and quality assurance of the monitoring process.

The Water Management System is already functional and operational in the Department's national office and one regional office, and is expected to be fully operational throughout the Department in 2007.

3.6.3.3 Groundwater

The mainframe-based National Groundwater Database has been replaced with a server-based system as a bridging solution until the web-enabled National Groundwater Archive becomes operational. The development of the system and the transfer of data is expected to be completed during 2004.

The archive will be linked to a proprietary information system that can provide management information on the quantitative and qualitative aspects of groundwater and surface water, as well as precipitation data. The system will also be linked to a package that models groundwater recharge, and the impacts of abstraction and aquifer contamination on groundwater systems.

The system has been installed in the Department's national office and three regional offices, and is expected to be fully operational in all regions during 2004.

3.6.3.4 Water use registration and authorisation

The Water Use Authorisation and Registration Management System (WARMS) is a comprehensive system designed to do the following -

- Manage the process of registering water use by storing the information needed to uniquely identify a water user, and characterise the location, nature and extent of the use.
- Manage the authorisation of water use by incorporating the workflow requirements for the licensing process from application, through evaluation, issue or refusal, to review. The information captured will include details of the evaluation of the application, any appeals against licensing decisions, licence conditions, licence and review periods, and any waivers granted on water use charges.
- Invoice water users based on established tariff structures, issue receipts and statements, account for revenue received and track outstanding water use charges. The financial component of WARMS is a secure system based on accepted accounting principles and includes an audit trail for every data item. Data security and stability is ensured by continuous data replication and updating between the systems at the Department's national and regional offices.
- Establish links with other national databases, such as the National Deeds Register, to facilitate validation of data and information.
- Produce reports on all of the above dimensions.

The registration component of the system has been in use since 2000. The cost recovery functions became operational on a pilot basis in 2002 and, after further development, were fully operational in 2003. The licensing capabilities are to follow in 2004 and establishing links with national databases operated by other departments will commence in 2004.

Note to Chapter 3, Part 6

¹ Section 67(2) of the Water Services Act states that the national information system for water services may form part of a larger system relating to water generally.

CHAPTER 3

PART 7 - DISASTER MANAGEMENT

(Provisions relating to actual or potential emergency or disaster situations are found in four places in the National Water Act, namely -

Section 67 allows the Minister to dispense with the requirement for public consultation in emergency situations or in cases of extreme urgency.

Part 3 of Chapter 14 requires township developers to indicate the 100 year flood line on plans, requires water management institutions to make information relating to floods, droughts and potential risks available to the public, and requires the Minister, where practicable, to establish early-warning systems.

Item 5 of Schedule 3 permits catchment management agencies to issue directives concerning waterworks to protect, among other things, the public or property.

Chapter 12 covers provisions relating to the safety of dams.)

3.7.1 INTRODUCTION

One of the objectives of the National Water Act (the Act) is to contribute to public safety and security in water matters. This Part gives a brief description of some of the water resources management activities that contribute to preventing the occurrence of water-related disasters and emergencies, and mitigating their effects when they do occur. Water-related disasters must be managed within the broad framework of national disaster management policy and legislation, and these requirements are also described.

3.7.1.1 Water-related disasters

Water-related disasters take many forms, and range in the extent of their influence from local to national. They threaten life, health and livelihoods, especially among the poor, and damage valuable infrastructure.

Floods occur naturally as a result of South Africa's highly variable climate, but they may also be caused by dam failures. They often cause loss of life and destruction of dwellings in communities living in the flood plains of rivers, and disrupt the provision of water by damaging dams, water and sewage treatment works, and water distribution systems. Floods damage roads, railways and bridges, and electricity and telecommunications infrastructure, inundate valuable agricultural land and destroy crops. Extreme rainfall events, often accompanied by high winds, not only cause floods, but also damage property, especially the less substantial dwellings in poorer communities.

Droughts can occur at any time, anywhere in the country, and often last for a number of years. They reduce the availability of water to all sectors of society, but their effects are particularly severe where people do not have access to piped potable water, or where they rely on run-of-river flows for their water supplies. Droughts prejudice food security by affecting production from irrigated and rain-fed agriculture, and disruptions in electricity generation and industrial output can have negative economic consequences.

Another threat is the pollution of water resources from spills of hazardous or toxic materials. These can render water unfit for use and damage the ecological functioning of water resources. Bacteriological pollution can cause outbreaks of diseases such as cholera. Communities that are not serviced by water supply schemes, and draw water direct from streams and rivers, are particularly vulnerable to the effects of pollution.

3.7.2 NATIONAL DISASTER MANAGEMENT POLICY AND LEGISLATION

3.7.2.1 The White Paper on Disaster Management

In the past, disaster management in South Africa was largely reactive, with disastrous events being handled as they were in progress, or the consequences being dealt with when the disaster was over. Dealing with disasters diverts resources from and retards the pace of social and economic development. There are clear advantages in preventing disasters or mitigating their effects.

National government began the process of developing a more holistic and proactive approach in 1994. In January 1999 the Department of Provincial Affairs and Constitutional Development (now the Department of Provincial and Local Government) published the White Paper on Disaster Management. The principal emphasis of the policy is on preparedness, prevention and mitigation: that is, reducing the potential for loss of life and injury, and the economic and environmental costs that result from disasters by taking appropriate steps aimed at -

- Increasing preparedness for disasters and improving response capacity among all sectors of society by, among other things, disseminating relevant information and undertaking programmes of awareness creation, education and training;
- Reducing the probability of disasters occurring and reducing the severity of the consequences when they do occur; and
- Reducing the vulnerability of communities, especially the poor and disadvantaged, to the hazards and threats posed by disasters.

To achieve these objectives the policy proposes that risk reduction strategies should be incorporated in all development planning and actions undertaken in the public and private sectors. Development plans will be prepared within the framework of coherent and integrated disaster management frameworks at national, provincial and district municipality levels. Responsibility for development of the frameworks will lie with disaster management centres established to co-ordinate all disaster management activities.

The policy recognises that the responsibility for disaster management rests primarily with government and that successful execution of its proposals will depend on co-operation among all spheres of government, as well as the development of co-operative and supportive relationships with civil society and the private sector.

The policy also reviews the prevailing funding arrangements in respect of disasters. It proposes a new financial framework to fund prevention, mitigation and preparedness actions and activities, to streamline and accelerate the provision of immediate relief to the victims of disasters, and to fund infrastructure repair work. The provision of government resources should not, however, discourage self-help or community involvement in disasters, nor should it replace the use of commercial insurance schemes.

3.7.2.2 The National Disaster Management Act

The disaster management policy proposals were given legal effect when the National Disaster Management Act (No. 57 of 2002) was promulgated in January 2003.

This Act established the National Disaster Management Centre (which formalises the Interim Disaster Management Centre, which has been in operation since 1997) as the national focal point for all disaster management activities. The Centre is mandated, among other things, to develop a National Disaster Management Framework and to establish communication links and information exchange arrangements with all disaster management role players. The National Disaster Management Act empowers the centre to require any organisation or person to provide information. The Department has been working closely with the Interim Disaster Management Centre for some time, providing support for the development of information systems and will continue this relationship with the .National Disaster Management Centre The Department's

anticipated responsibilities and obligations in terms of the new legislation are discussed below and also in Chapter 5.

3.7.3 THE DEPARTMENT'S ROLE IN DISASTER MANAGEMENT

The Department's responsibilities for disaster management under the Act, as summarised in section 2, concern the management of floods and droughts, the reduction and prevention of pollution and degradation of water resources, and the promotion of dam safety. The Department has additional responsibilities in terms of the National Disaster Management Act.

3.7.3.1 Disaster management planning

The Department, in common with all other organs of State with disaster management responsibilities, will be required to prepare a disaster management plan within the National Disaster Management Framework. The Department will also need to ensure that disaster management planning is included in catchment management strategies and the business plans of water user associations. It will have to see to it that provisions for water-related disasters in respect of water services are incorporated into the Water Services Development Plans of water services authorities and the business plans of water boards.

3.7.3.2 Floods

South Africa's climate is highly variable and largely unpredictable, and the primary purpose of most dams is to store water during periods of above-average rainfall to provide water during dryer periods that may follow. Dams can, however, also play an important role in flood management since they reduce high flow rates entering the dam to lower flow rates exiting the dam to the river downstream. This is known as flood attenuation, and it occurs in every dam, even when the reservoir is full when the floodwaters enter. The attenuation effect can be increased by deliberately releasing water from storage prior to the onset of the flood to provide additional storage to accommodate floodwaters before the dam starts to spill. A small number of dams are equipped with crest gates to provide flood storage above the normal full supply level, whilst a few have high capacity outlets that could facilitate pre-flood releases.

In general, though, most dams are not equipped to release water from storage sufficiently rapidly to significantly increase their attenuation effect. However, as the purpose of dams is to store as much water as possible for as long as possible against an uncertain future, pre-flood releases can, in most cases, only be made when there is reasonable certainty that the dam will be full again when the flood has passed. This requires sound information and predictive capability on the probable extent of the incoming flood, which is not available in most catchments. (Information requirements for disaster management are discussed below).

A few dams have been designed specifically for flood attenuation - the Qedusizi Dam on the Klip River upstream of Ladysmith in KwaZulu-Natal, for example. Such dams remain empty for most of the time, containing water only during flood events. Whilst such structures are effective for flood management, they are costly and inefficient as far as water resources management is concerned. It is preferable, where it is necessary to contemplate structural solutions to flooding problems, to operate multi-purpose water supply dams to maximise attenuation during flooding events, and to ensure that effective warning systems are in place.

The National Disaster Management Centre has established a number of working groups, each of which will prepare a component of the National Disaster Management Framework. The Department leads the working group to develop a national flood management policy. It is anticipated that the group will interact closely with representatives of, among others, the urban, transport, agriculture and services (telecommunications and power supply) sectors.

The flood management policy will include proposals on guidelines and standards, and institutional responsibility with regard to the following -

- The operation of large storage dams in a manner that optimises the conflicting requirements of providing security of water supply and protection of downstream areas.
- The safe and sustainable use of the floodplains of rivers. Much of the risk to life and property associated with floods is the result of the inappropriate occupation and use of floodplains and other flood-prone areas. This is especially so in urban areas, where floodplains are often the only available land where people - usually the poor - are able to establish residences close to employment opportunities.
- Design criteria for services infrastructure such as roads, bridges and waterworks situated on or adjacent to rivers, to achieve an optimal balance between affordability and the need for structural robustness to resist damage during floods.
- Effective flood warning systems for all flood-prone areas, combined with programmes for public and institutional education, training and awareness creation.
- Interactions and co-operative relationships with countries with which South Africa shares river systems.

3.7.3.3 Dam safety

Dam failures and incidents such as the failure or unauthorised opening of a gate can cause devastating floods. The Act places the responsibility for ensuring the structural and operational safety of dams on the dam owners.

The Dam Safety Office, located in the Department's national office in Pretoria, administers the Act's provisions relating to the safety of all new and existing dams with a safety risk in South Africa^[1]. These provisions are intended to ensure that such dams are designed, constructed, operated and maintained to minimise the risk of loss of life or damage to property and the quality of water resources as a result of dam failure or operational shortcomings. All dams with a safety risk must be registered with the Department.

The design, construction and abandonment of Category II and III dams with a safety risk (see Note 1) must be carried out by suitably qualified people, defined in the Act as approved professional persons. The owners of such dams, including the Department, are also required to have their dams inspected regularly by an approved professional person, and to make any necessary repairs or alterations to ensure the safety of the dam. Alterations, and in certain cases maintenance and repairs, must be supervised by an approved professional person.

Owners of Category II and III dams with a safety risk are also required to prepare and submit to the Dam Safety Office an operation and maintenance plan and an emergency preparedness plan. The latter must detail the actions to be taken in the event of an actual or imminent dam failure, or any other emergency situation relating to the dam. The plan must contain details of the downstream areas that would be affected by dam failure and the ways in which warnings would be given to people at risk.

The Department is preparing new regulations relating to the safety of dams in terms of section 123 of the Act. These will replace the regulations made under the 1956 Water Act. The drafting process is substantially complete and, after public consultation and approval by Parliament, the regulations are expected to be established during 2004.

When these regulations are in place, the existing regulations governing the activities of the Advisory Committee on Safety of Dams^[2] (see Part 5 of this chapter) will be reviewed and revised where necessary to accord with the provisions of the Act. Regulations may also be prepared relating to financial assistance in matters relating to the safety of dams.

The functional responsibility within the Department for compliance with dam safety legislation in respect of dams owned, operated and maintained by the Department is clearly separated from the responsibility for dam safety regulation.

3.7.3.4 Droughts

Drought management from a water resources perspective is concerned mainly with mitigating the effects of prolonged periods of lower-than-average runoff in streams and rivers, referred to as "hydrological droughts", by providing water to users from storage dams. However, because the duration of droughts cannot at present be predicted with any certainty, water in storage dams must be used judiciously and it may be necessary to impose restrictions on water use when there are indications that drought conditions are imminent or when a drought continues longer than expected. Where restrictions are necessary, water to meet basic human needs will always receive priority in allocations, followed by strategically important uses such as power generation and key industries. In general, water for irrigation is restricted first. However, recognising the negative impacts of such restrictions, the Department will aim to provide notice to organised agriculture of their need as early as possible.

Most of South Africa's agricultural land is under rain-fed cultivation, which is dependent on sufficient rainfall to maintain adequate levels of soil moisture for plant growth. Water stored in dams offers no protection against "soil moisture deficit" drought conditions caused by lower-than-average rainfall. Even so, this situation is of concern to water resource managers since the degradation of vegetal cover can result in soil erosion, which will lead to sediment being deposited in rivers and dams, and a consequent reduction in storage capacity. The Department will therefore co-operate with the national Department of Agriculture, which leads the drought working group established by the National Disaster Management Centre, in developing measures aimed at mitigating the effects of drought. The Department's interest in this regard lies particularly in the area of information management (see below). It is anticipated that the working group will clarify the institutional responsibilities for dealing with the various dimensions of droughts.

3.7.3.5 Pollution of water resources

The Department's approach to water quality management (see Part 2 of this chapter) is to promote the reduction of discharges of waste or water containing waste into water resources. Where waste discharges are unavoidable, the impact on other users, water resources and the general public are controlled by specifying the permissible levels and concentrations of the constituents of the discharge in the conditions of use authorisations.

In emergency situations, where harmful substances are accidentally or negligently discharged into water resources, the Act makes those who have caused the pollution responsible for remedying its effects. However, catchment management agencies may, where necessary, accelerate the clean-up process by arranging for the work to be done by others and recovering any costs incurred from the responsible party. At present all pollution incidents must be reported to the Department so that appropriate responses can be co-ordinated, in conjunction with the National Disaster Management Centre, with the relevant emergency services and disaster management centres. Ultimately this responsibility will be passed to the catchment management agencies.

Pollution from diffuse sources such as informal settlements is extremely difficult to control at source. Inadequate sanitation facilities in such areas can result in the bacterial pollution of water resources, which may cause outbreaks of diseases such as cholera among people who use water directly from rivers. Until water supply and sanitation services can be improved throughout the country, this situation may lead to outbreaks of disease whose management will require close co-operation between the Department, water services authorities, and health and other emergency services. The National Disaster Management Centre has co-ordinated the development of an inter-departmental strategy to deal with cholera, and this provides the framework for dealing with such disease outbreaks.

3.7.3.6 Information for disaster management

The timely availability of information about potential, imminent or actual hazards is an essential requirement if institutions and the public are to be prepared for disaster situations. The information is needed to enable managers to decide on the most effective responses, including giving informed warnings to the public that may be at risk.

Two specific requirements of the Act in this regard are -

- section 144^[3] requires township developers to indicate the 100 year flood lines on their plans; and
- section 145^[4] requires all water management institutions, including the Department, to make information they have at their disposal available to anyone who may be affected by water-related incidents and events.

The requirements of section 145, together with the new requirements of the national disaster management legislation, emphasise the importance of improving and extending existing monitoring systems, and the development of information systems (see Part 6 of this chapter).

In respect of relatively rapid-onset events such as floods, dam breaks and pollution incidents, special attention will be given to improving facilities at strategic monitoring sites so that data can be transmitted as rapidly as possible to the Department and other relevant agencies. The Department will also strengthen its capacity to analyse the data and distribute it, either direct or via the National Disaster Management Centre, to communities threatened by an event.

With regard to floods, only the Vaal and Orange River Systems are considered to have adequate infrastructure to monitor rainfall and river flows that make it possible to provide acceptable flood warnings. The Flood Office at the Department's national office is called into operation when potential flood conditions arise in these river systems. It is planned to expand the capability of this office by introducing the use of river-flow forecasting models that can incorporate real-time rainfall information from the South African Weather Service's C-band radar installation network.

Elsewhere in the country flow gauging stations will be improved to enable them to measure and record flood flows, especially where infrastructure developments and residences are at risk on flood plains. Similar steps will be taken on rivers that are shared with neighbouring countries downstream.

The ability to predict the onset of floods and droughts requires rainfall data as well as stream flow information, but the size and extent of South Africa's rain gauge network has progressively decreased in recent years. The Department will work closely with the National Disaster Management Centre, the South African Weather Services and the Agricultural Research Council, all of whom collect rainfall data, to ensure that adequate rainfall data continues to be available to water resources and disaster managers.

Pollution incidents, especially those involving microbiological pollution and the presence of toxic matter in water resources, are a threat to human health. Attention will be given to improving water quality monitoring networks to detect such contamination and to ensure that relevant information is rapidly available to those at risk.

As part of its work with the National Disaster Management Centre the Department is leading the development of a disaster vulnerability atlas. This will capture and display all relevant information, for example topography, land use, rainfall and demography. that is required to support decision-making in emergencies and disaster situations. The development of a standard precipitation index as part of the atlas will provide a means of monitoring trends in soil moisture and surface and ground water to facilitate predictions of impending drought and flood conditions.

3.7.3.7 Departmental disaster management structures

The Department is in the process of developing internal organisational structures to deal with its responsibilities relating to disasters and emergencies in water resources management, water services and forestry.

During recent years the Department has had to deal with a series of potential or actual disaster situations and circumstances, as follows -

- In 1997/98 many parts of the country experienced drought conditions as a result of the Equatorial Pacific Ocean El Niño phenomenon. This necessitated the provision of emergency water supplies to communities that experienced water shortages and a review – and the acceleration, where necessary – of water services projects to reduce future vulnerability.
- At the end of 1999 all computerised and other date-dependent electronic systems used in the Department were reviewed against the threat of disruption by the Year 2000 (Y2k) rollover event. The Department also co-ordinated the preparation of emergency and contingency plans for the entire water sector, and monitored the date rollover.
- Devastating floods occurred in the north and north-east of the country in February/March 2000, disrupting water supplies to millions of people and causing damage to property and infrastructure estimated at a total of about R3 500 million, including damage of about R350 million to State-owned waterworks.
- In August 2000 a cholera epidemic caused many deaths in the eastern parts of the country, prompting the Department to accelerate programmes for the provision of basic water supply and sanitation services.
- A drought that began with below average rainfall in the summer rainfall areas in the 2002/2003 season persisted into the following year, necessitating emergency programmes to maintain basic water supplies.

Although the events were dealt with satisfactorily, they highlighted the need for a more integrated and focused approach to co-ordinating departmental activities and responses. It is anticipated that responsibilities in this respect will include -

- Ensuring that the Department meets its obligations under the National Disaster Management Act (see Chapter 5).
- Representing the Department in and co-ordinating all departmental interactions with relevant structures established by the new disaster management legislation, including the National Disaster Management Centre.
- Ensuring a two-way flow of relevant information between the Department and the National Disaster Management Centre.
- Contributing to the development of the National Disaster Management Framework and the preparation of the Department's disaster management plan as required by the National Disaster Management Act.
- Co-ordinating the activities of existing departmental units that are responsible for aspects of public safety.
- Ensuring that disaster management planning is incorporated into all catchment management strategies and the business plans of water user associations.
- Ensuring that contingency plans for water-related disasters are included in all Water Services Development Plans and business plans prepared by water services authorities and institutions.
- Ensuring effective communication with water user sectors in respect of possible supply restrictions due to drought.

Notes to Chapter 3, Part 7

¹ "Dam with a safety risk" means any dam (i) which can contain, store or dam more than 50 000 cubic metres of water, whether that water contains any substance or not, and which has a wall of a vertical

height of more than five metres, measured as the vertical difference between the lowest downstream ground elevation on the outside of the dam wall and the non-overspill crest level or the general top level of the dam wall; (ii) belonging to a category of dams declared under section 118(2) to be dams with a safety risk; or (iii) declared under section 118(3)(a) to be a dam with a safety risk (section 117(c)).

It should however be noted that regulations in terms of Section 9C(b) the Water Act, 1956 relating to dams with a safety risk (Government Notice R.1560, 25th July 1986) categorise dams with a safety risk into three category classes, I, II and III, which relate to the size class of the dam and its hazard potential rating, and where Category III represents the highest hazard potential rating.

² Regulations governing the establishment, constitution and functions of the Advisory Committee on Safety of Dams, made under the Water Act, 1956, Government Notice R.1876, 23rd August 1985.

³ Flood lines on plans for the establishment of townships - section 144: For the purposes of ensuring that all persons who might be affected have access to information regarding potential flood hazards, no person may establish a township unless the layout plan shows, in a form acceptable to the local authority concerned, lines indicating the maximum level likely to be reached by floodwaters on average once in every 100 years.

⁴ Duty to make information available to public - section 145: (1) A water management institution must, at its own expense, make information at its disposal available to the public in an appropriate manner in respect of (a) a flood which has occurred or which is likely to occur; (b) a drought which has occurred or which is likely to occur; (c) a waterwork which might fail or has failed, if the failure might endanger life or property; (d) any risk posed by any dam; (e) levels likely to be reached by floodwaters from time to time; (f) any risk posed by the quality of any water to life, health or property; and (g) any matter connected with water or water resources, which the public needs to know. (2) The Minister may, where reasonably practicable, establish an early warning system in relation to the events contemplated in subsection (1).

CHAPTER 3

PART 8 - ANTICIPATED PROGRAMME OF IMPLEMENTATION ACTIVITIES

3.8.1 INTRODUCTION

In this Part an indicative multi-year programme is presented for the implementation of the National Water Act (the Act) throughout the country. The programme is closely related to the Strategic Plans that the Department is required to prepare in terms of the Public Finance Management Act (see Chapter 5).

Given the size and complexity of many of the activities described, the programme is only indicative and should not be regarded as a rigid master plan. The programme will be reviewed in the light of experience gained during the currency of the First Edition of the National Water Resource Strategy (NWRS) and amended as necessary when the NWRS is reviewed.

Activities are grouped under three broad headings: operational activities; activities relating to water sharing arrangements with neighbouring countries; and the development of physical infrastructure.

This Part should be read with Part 9 of this chapter, which provides indicative costs of the activities discussed.

3.8.2 OPERATIONAL ACTIVITIES

Operational activities relate to all ongoing activities required for the protection, use, development, conservation, management and control of South Africa's water resources. There are two broad groups of activities: routine operational activities; and commissioning or establishment activities.

3.8.2.1 Routine operational activities

This group comprises activities that will be routinely undertaken for as long as the Act remains in force, and includes -

- The reconciliation of water requirements and water availability.
- The planning and design of capital works.
- The operation and maintenance of bulk water supply systems and schemes.
- Control of water use.
- Water conservation and demand management.
- The setting of tariffs and the collection of revenue.
- The collection, storing, analysis and dissemination of water-related information.
- Dam safety control.
- The control of invasive alien vegetation.

The individual programmes against which these routine activities are undertaken are not presented in this document.

3.8.2.2 Commissioning/establishment activities

This group comprises activities, all of which are new requirements of the Act, which will be undertaken only once and will have a finite (although in some cases rather long) duration. These are referred to as commissioning or establishment activities and they are intended to create an environment in which the efficiency and effectiveness of water resources management can be

progressively improved. They are of considerable magnitude and neither financial nor human resources are available to undertake them simultaneously in all 19 water management areas. Accordingly, they have been prioritised to reflect the needs and circumstances in each area. The activities included in this category are the following -

- Compulsory licensing.
- The establishment of catchment management agencies.
- The delegation of operational responsibility for physical infrastructure and transfer of the ownership of infrastructure to water management institutions.
- The establishment of new water user associations.
- The expansion of existing monitoring networks and information systems, and the establishment of new ones.

A further three operational activities require immediate attention and will be undertaken simultaneously in all water management areas -

- The introduction of revenue collection in terms of the water resources management charge.
- The completion of the transformation of irrigation boards into water user associations.
- The streamlining of the individual licence applications process so as to reduce delays.

The intention is to complete these three activities in all water management areas over a period of about two years.

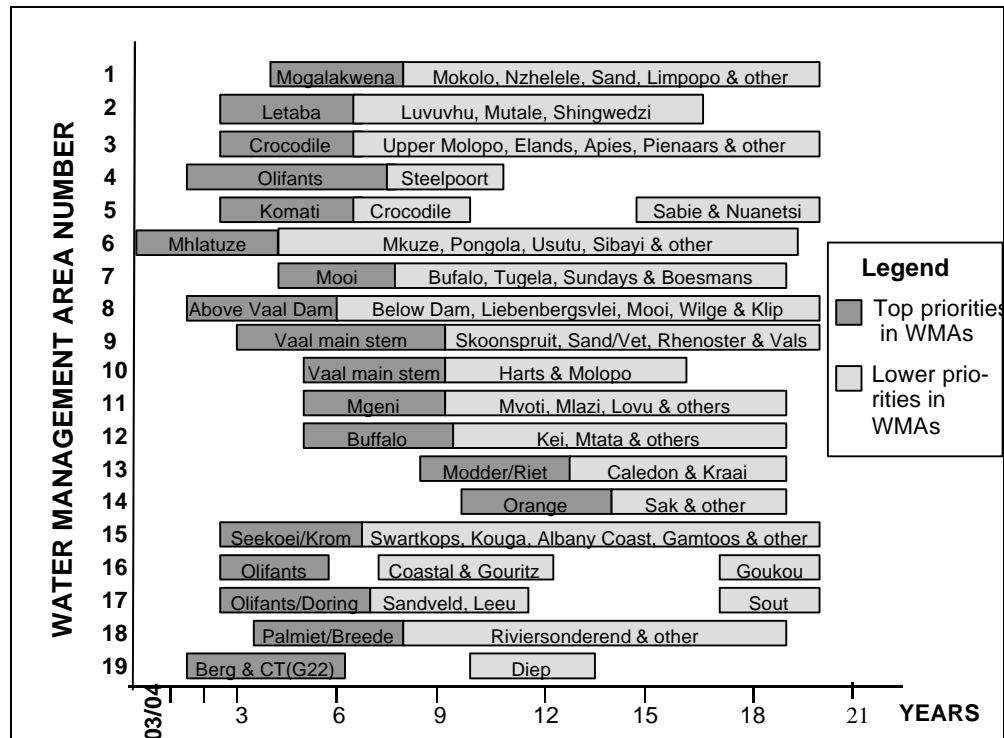
The indicative programmes for compulsory licensing, the establishment of catchment management agencies and the transfer of responsibilities related to infrastructure to water management institutions are presented in Figs 3.8.1, 3.8.2 and 3.8.3 respectively. A revised programme may be presented in the Second Edition of the NWRS.

Compulsory licensing

The process of compulsory licensing comprises -

- Verification of existing water use.
- Determination of water resource availability.
- Classification of the water resource.
- Setting of resource quality objectives.
- Determination of the Reserve.
- Development of components of the catchment management strategy.
- Calling for and evaluation of licence applications.
- Preparation of water allocation schedules and undertaking public consultation on them.
- Announcing water use allocations in the *Government Gazette*.
- Issuing licences.

Fig. 3.8.1: Indicative programme for compulsory licensing



The country has been divided into approximately 100 surface and groundwater resources at catchment scale for the purposes of compulsory licensing.

The criteria used for prioritising water resources for compulsory licensing included -:

- The extent to which water resources are under stress from over-utilisation.
- The need for water for rural development and poverty eradication.
- The urgency of implementing the Reserve requirements for ecological functioning.
- The need to satisfy international requirements and obligations.
- Projected increases in the demand for water.
- Water quality problems.
- Interactions between surface and groundwater.

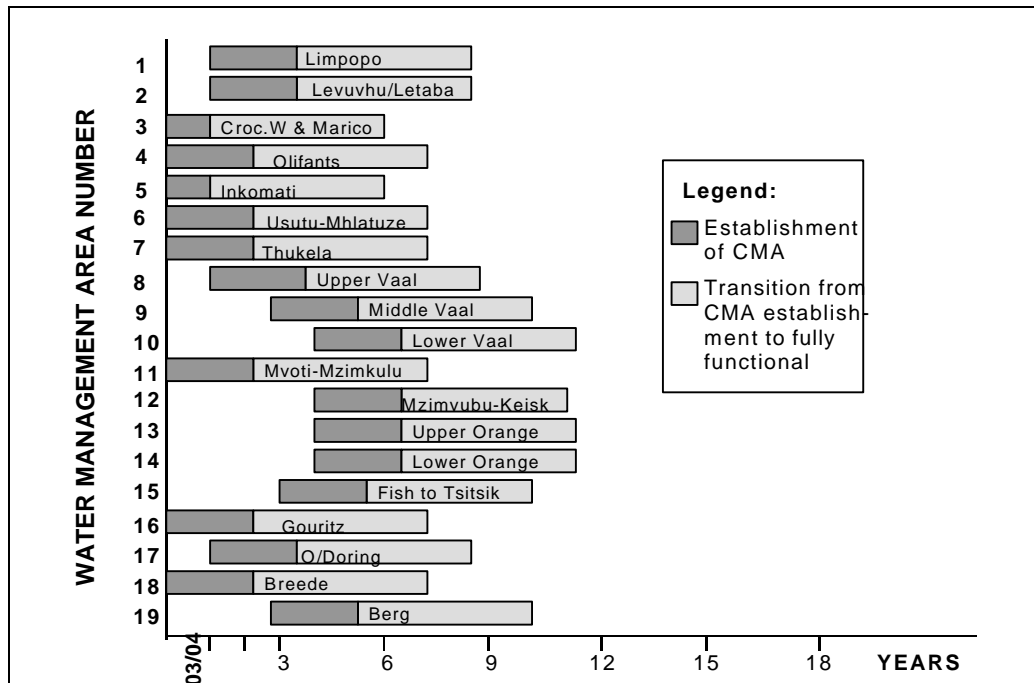
Compulsory licensing will be carried out in a number of catchments on a pilot basis. The experience gained at each stage will inform the ways in which compulsory licensing is carried out in the other areas. In addition, a number of stressed groundwater systems will be prioritised for compulsory licensing to prevent the continuation of current over-utilisation and the possibility of long-term damage to the systems.

Establishment of Catchment Management Agencies

Five water management areas have been identified where the establishment of catchment management agencies is urgent. These are the Inkomati, Olifants, Breede, Crocodile West and Marico, and Mvoti to Mzimkulu. The process of preparing an establishment proposal to the Minister is farthest advanced in the Inkomati water management area.

Depending on the complexity of the water management area, a period of two to three years has been allowed for the process of establishing the agency and appointing the governing board. A further five years will most likely be required for developing and establishing the executive structure of the agency.

Fig. 3.8.2: Indicative programme for establishing catchment management agencies



The following criteria were used for prioritising the establishment of catchment management agencies -

- The extent to which service delivery will be enhanced by the establishment of an agency.
- Anticipated revenue from water resource management charges to fund the agency's operations.
- Stakeholder expectations and their preparedness to participate in and progress with the establishment process.
- Priorities under the Integrated Rural Development Programme and other government programmes.
- Priority for compulsory licensing in the area.
- Anticipated developments that will require licensing. .

Delegation of functions and transfer of infrastructure to water management institutions

There are two distinctly different types of transfer to be considered, namely -

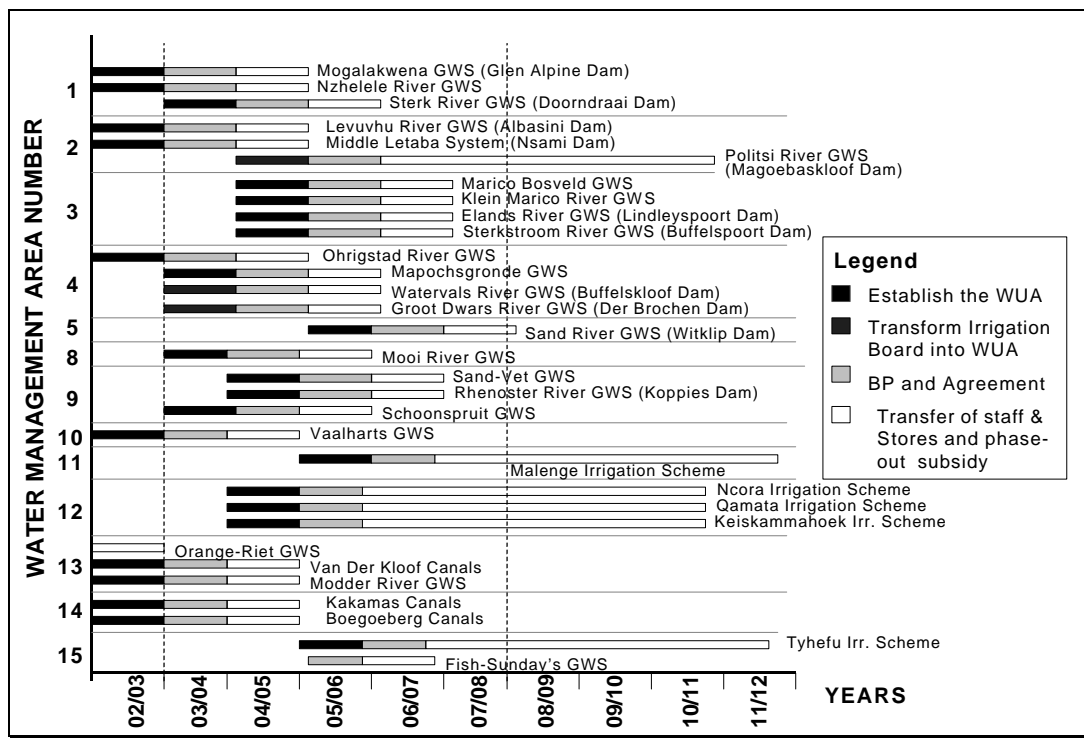
- The transfer, by delegation, of the operation and maintenance functions.
- The transfer of the ownership of the physical infrastructure (dams, canals, pipelines) to the institution.

The policy for transferring the ownership of existing State-owned and operated infrastructure is being developed. The optimal institutional arrangements for the development of new water resources infrastructure in general, and the development and management of schemes that include dams in particular, is under investigation.

At this stage, therefore, the programme provides information only on the proposed transfer of operation and maintenance responsibilities for irrigation schemes with distribution infrastructure - canals and pipelines - to water user associations. Where a dam forms part of an irrigation scheme, the operation and maintenance functions in respect of distribution infrastructure only will be delegated to associations, while the Department will continue to operate the dam. The associations' performance in carrying out the operation and maintenance responsibilities will be

monitored for up to five years before consideration is given to transferring the ownership of the assets.

Fig. 3.8.3: Indicative programme for delegating operation and maintenance functions to water user associations



There are five water user associations for which a five-year transfer phase is indicated because of the need to phase out subsidies to emerging farmers in terms of the pricing strategy (see Part 4 of this chapter). For the others the transfer period could be as little as one year.

The criteria that were used to prioritise the transfer of operation and maintenance responsibilities to water user associations included the following -

- The capacity of an association to take on the responsibilities.
- The extent to which service delivery would be improved by the transfer.
- The extent to which the infrastructure had been valued and appeared on an asset register.
- The effects of the transfer on the Department's staffing levels.

Responsibility for scheme operation and maintenance has already been delegated to water user associations on the following schemes -

- Crocodile River GWS (Hartbeespoort Canals) in WMA 3 (Crocodile West and Marico).
- Krokodilpoort GWS (Malelane Canals) in WMA 4 (Inkomati).
- Olifants River (Loskop) GWS in WMA 5 (Olifants).
- Pongola River GWS in WMA 6 (Usutu to Mhlathuze).
- Orange-Vaal GWS (Douglas Canals) in WMA 10 (Lower Vaal).
- Vaalharts GWS in WMA 10 (Lower Vaal).
- Leeu River GWS (Armenia) in WMA 13 (Upper Orange).
- Riet River GWS (Kalkfontein Canals) in WMA 13 (Upper Orange).
- Orange-Riet GWS in WMA 13 (Upper Orange).
- Gamtoos River GWS in WMA 15 (Fish to Tsitsikamma).

- Olifants River (Van Rhynsdorp) GWS (Clanwilliam and Vredendal Canals) in WMA 17 (Olifants/Doring).
- Elands River GWS (Villiersdorp) in WMA 18 (Breede).
- Korente Vette GWS in WMA 16 (Gouritz).
- Kammanassie River GWS in WMA 16 (Gouritz).
- Olifants River (De Rust) GWS in WMA 16 (Gouritz).
- Goukou GWS in WMA 16 (Gouritz).

Establishment of new water user associations

New water user associations will be established as the need arises. (see Part 5 of this chapter). It will however be necessary to establish new water user associations for some schemes so that the responsibility for operation and maintenance can be delegated to them and, ultimately, when the policy is established, the physical assets transferred to their ownership. The process of establishing an association in the Kat River (WMA 15 - Fish to Tsitsikamma) is in progress, and an association will be needed, for instance, for the operation and maintenance of the Sterk River GWS (WMA 1 – Limpopo).

Expansion of monitoring networks

- **Surface water - flow monitoring:** The proposed expansion of the monitoring network - national flow points, operational flow monitoring sites and meteorological stations - is expected to take between 20 and 25 years. Some infrastructure, such as gauging weirs, will be required. Improvements in the national flow point network are required in the following water management areas, in order of priority: Crocodile West and Marico (WMA 3); Berg (WMA 19); Olifants (WMA 4); Mzimvubu to Keiskamma (WMA 12); Usutu to Mhlathuze (WMA 6); Limpopo (WMA 1); Breede (WMA 18); Luvuvhu/Letaba (WMA 2); Gouritz (WMA 16); Inkomati (WMA 5); Thukela (WMA 7); and Olifants/Doring (WMA 17).
- **Surface water - water quality monitoring -**
 - Microbial monitoring:** Expansion of the network to cover all water management areas is expected to be completed by 2007.
 - Eutrophication monitoring:** Expansion of the network from 50 to 100 reservoirs is scheduled for completion by 2012.
 - Biological monitoring:** The programme is expected to be operational in at least one major catchment in each province by 2006, and to produce a State of the Rivers Report for all major river systems by 2008.
 - Toxicity monitoring:** Programme planning and design is expected to be complete by 2010.
 - Radioactivity:** Programme planning, design and implementation is scheduled for completion by 2012.
- **Groundwater monitoring:** Guidelines for the expansion of the national monitoring network from its present 150 points to the required 460 points will be available during 2004 and the planned expansion is expected to be completed by 2006. Implementation will be prioritised to accord with the programmes for compulsory licensing and provision of water services from groundwater sources.

Development of information systems

- **Surface water hydrology:** The new system was installed in the Department's national office during 2002 and is expected to be fully operational in all departmental regional offices during 2004.
- **Water quality:** The Water Management System is functional and operational in the Department's national office and in one regional office. The system is expected to be fully operational throughout the Department in 2007.

- **Groundwater:** The national groundwater information system was installed in the Department's national office and three regional offices by the end of 2002, and is expected to be fully operational in all regions by 2004.
- **Water use registration and authorisation (WARMS):** The registration component of the system has been in use since 2000. The cost recovery functions were operationalised in early 2002, with the licensing capabilities followed in 2003. Links with national databases operated by other departments should be established in 2004.

3.8.3 INTERNATIONAL WATER-SHARING AGREEMENTS

An indicative programme for the establishment of international institutions, the completion of basin studies and the establishment of water sharing agreements is presented in Table 3.8.1. In addition to the major initiatives outlined in the Table, the various bi- and multi-lateral committees and commissions also negotiate agreements concerning such matters as information sharing among States and the necessity for water resources management interventions to ensure that the interests of all relevant countries are safeguarded. Water resources management interventions may deal with issues such as water quality, extreme flow events or ecological issues.

Table 3.8.1: Indicative programme for international water sharing agreements

Shared watercourses	Neighbouring countries sharing the watercourse	Programme for studies and agreements	Date
Orange	Botswana Lesotho Namibia	• Orange-Senqu Basin Commission (established)	2000
		• Lower Orange River Management Study (RSA/Namibia) initiated	Mid-2003
		• Lesotho Highlands Water Project – Further Phases Pre-Commitment Study	2005
		• Feasibility study for the sustainable development of Molopo-Nossob Watercourse	2004
		• Integrated water resources management plan for Orange-Senqu Basin	2005
Limpopo	Botswana Mozambique Zimbabwe	• Treaty to establish the Limpopo Basin Commission signed	2003
		• Limpopo Basin Study	2004
Inkomati	Mozambique Swaziland	• Joint Inkomati Basin Study completed	2002
		• Interim Water Sharing Agreement signed	2002
		• Treaty to establish Inkomati Basin Commission	2004
		• Comprehensive Water Sharing Agreement	2009
Maputo	Mozambique Swaziland	• Interim Water Sharing Agreement signed	2002
		• Treaty to establish Maputo Basin Commission	2004
		• Maputo Basin Study	2005
		• Comprehensive Water Sharing Agreement	2010

3.8.4 DEVELOPMENT OF PHYSICAL INFRASTRUCTURE

3.8.4.1 Major government waterworks

In terms of its current mandate the Department has investigated the necessity for the construction of a number of major government waterworks comprising dams and, where necessary, associated infrastructure such as pumping stations, pipelines and canals, to meet projected future water needs. The investigations formed part of the integrated approach to finding solutions to problems of water availability described in Chapter 2, which includes water demand management and conservation. These schemes are listed in Tables 3.8.2 and 3.8.3 at the end of this part. The following should be noted -

- **Inclusion of a scheme as a possible development does not constitute a commitment to proceed with the scheme.**
- In general, only schemes that may be required by or before 2025 are mentioned. The preferred options are listed with, where relevant, an indication of alternative options that were investigated.
- More details about the need for and alternatives to the schemes are provided in Chapter 2 and Appendix D. Other possible developments that may be required after 2025 are mentioned in Appendix D.
- More detailed investigations will be undertaken for schemes that impact only at catchment level or within a single water management area when catchment management strategies are developed. The Department (or an agency to manage such infrastructure, if it is established - see Part 5 of this chapter) will remain responsible for schemes that affect more than one water management area, schemes of a strategic nature and schemes with international implications.
- All developments will be the subject of social and environmental impact assessments as well as economic feasibility studies.

Schemes intended primarily for irrigation purposes

The schemes listed in Table 3.8.2 have been proposed either to enable new irrigation areas to be established, or to improve the reliability of supply to existing irrigation schemes during times of water shortage. New irrigation areas could include the development of irrigation farming among emerging farmers.

The feasibility of many of the schemes has not yet been determined and it is possible that they will not prove to be economically viable in terms of irrigators being able to pay all water use charges relating to establishment (capital), operating and maintenance costs. Some schemes may only be economically feasible if capital subsidies are made available to cover the cost of establishing the infrastructure. However, although subsidies will continue to be provided to support the establishment of merging farmers, at present it is not government policy to subsidise large-scale irrigated agriculture. The environmental and social impacts of these schemes have not yet been fully investigated.

Accordingly, no firm required completion dates are proposed for any of the schemes. However, should government policy with regard to the development of irrigated agriculture change, the schemes could be completed by the possible completion dates indicated. These dates make allowance for the time required to plan, design and construct the schemes and take into account any preparatory work that has already been carried out. The possible completion dates do not, however, make allowance for the often considerable period it takes for the impoundment to fill after completion of the dam wall.

Schemes intended primarily for domestic, urban, industrial or mining purposes

The schemes listed in Table 3.8.3 are being or will be investigated because the base water demand scenarios (see Chapter 2 and Appendix D) indicate that requirements for water in the relevant water management areas already exceed water availability, or will do so before 2025. Only a possible completion date is indicated for each scheme. As for irrigation schemes, the possible completion dates allow for the time required for planning, design and construction and take account of any investigations that have already been carried out, but do not allow for the simultaneous planning, design and construction of all the schemes.

It should be noted that the demand scenarios make allowance for the immediate provision of water to meet ecological Reserve requirements. This will take some time to implement fully. In addition, the demand scenarios make no allowance for the implementation of water conservation and demand management measures. The combined effect of the progressive implementation of ecological Reserve requirements and successful water conservation and water demand

management measures could, in many cases, serve to delay the requirement for supply augmentation well beyond the possible completion date. In most cases the possible delay has not yet been reliably quantified, and is receiving the Department's attention.

The following other two important schemes have been investigated, but are not included in Table 3.8.3 because demand scenarios indicate that supply augmentation is unlikely to be required during the planning period to 2025 -

- The Thukela Water Project for the transfer of water from the Thukela River to the Vaal River System to meet increasing urban and industrial demand in Gauteng and surrounding areas. The scheme under investigation, with an anticipated yield of 510 million m³/a, comprises the construction of dams on the Thukela River (at the Jana site) and the Bushmans River (at the Mielietuin site) and transfer aqueducts. Possible alternatives to meet rising demand in the Vaal System are transfers of water from the proposed Mashai Dam in Lesotho (Phase 2 of the Lesotho Highlands Water Project) and a dam at the Orange/Kwaai confluence (at the Boskraai site) in the Upper Orange water management area.
- The Thukela-Mhlathuze Transfer Scheme, which could transfer a maximum of an additional 54 million m³/a from the Thukela River into the Mhlathuze water management area for possible mining and industrial developments. Water could be abstracted from sites on the Thukela at Mandini for use at the Fairbreeze mine, or at Middeldrift, via Goedertrouw Dam, for use at Richards Bay and surrounding areas.

Table 3.8.2: Possible future large-scale water resource developments, primarily for irrigation purposes

WMA	Name of dam site / scheme ⁴	River	Province	Use	Required completion date	Possible completion date	Estimated yield or increase in yield ⁵ (mill m ³ /a)	Comments
2	Tzaneen Dam raising and a dam at nWamitwa	Letaba	Limpopo	Irrigation, domestic	Undefined	2007	50	The need for the development will depend on growth in requirements and the socio-economic impacts of ecological Reserve requirements. Possible impacts on Mozambique must be considered.
6	Dam at Embiane	Black Mfolozi	KwaZulu-Natal	Irrigation, domestic	Undefined	2009	10	Development proposed for settlement of small farmers, subject to feasibility. dam at Sikwebezi is a possible alternative.
14	Dam at Violsdrif	Orange	Northern Cape	Irrigation, improved operation of Orange River System	Undefined	2012	150	Possible joint development with Namibia. Study in progress.
17	Raising of Clanwilliam Dam	Olifants	Western Cape	Irrigation	Undefined	2009	10	Study underway. Improvements required to the existing dam wall for safety reasons could make simultaneous raising viable.
17	Dam at Melkboom	Doring	Western Cape	Irrigation	Undefined	2011	121	Study underway. Dam at Aspoort is an alternative.

Notes:

1. See explanatory text in section 3.8.2.1.
2. Only schemes that may be required by or before 2025 are listed.
3. **The listing of an option does not imply any commitment to proceed with the development of the scheme.**
4. The name of dam site usually refers to the name of the farm on which the dam wall is to be situated.
5. Except where indicated, estimates of yield or increase in yield are current at February 2003 and are consistent with water availability figures elsewhere in the NWRS. They will be refined as necessary should work on the project be progressed.

Table 3.8.3: Possible future large-scale water resource developments, primarily for domestic, urban, industrial or mining purposes

WMA	Name of dam site / scheme ⁴	River	Province	Use	Possible completion date	Estimated yield or increase in yield ⁵ (mill m ³ /a)	Comments
4	Raising of Flag Boshielo Dam	Olifants	Mpumalanga	Mining, urban, industrial in Olifants and Limpopo WMAs	2005	16	Includes possible transfers to Limpopo WMA. The raising has been approved, and construction is in progress.
4	Dam at De Hoop	Steelpoort	Mpumalanga	Mining, domestic (urban and rural)	2010	90 ⁶	To meet growth in mining and domestic requirements in the Polokwane, Mokopane (WMA 1), Steelpoort, Burgersfort, Lebowakgomo and Nebo areas (WMA 4).
4	Dam at Rooipoort	Olifants	Limpopo	Mining, domestic (urban and rural)	2010	45 ⁶	Possible future phase to follow De Hoop when yield is fully utilised, serving the same areas.
5	Dam at Mountain View	Kaap	Mpumalanga	Domestic, irrigation	2012	64	Possible joint development with neighbouring countries
5	Dam at Boekenhoutrand	Komati	Mpumalanga	Power generation, irrigation	2012	50	Will depend on the impact on the existing system of implementing the Reserve.
7	Dam at Springgrove and aqueduct	Mooi	KwaZulu-Natal	Transfer to Umgeni system. Urban, industrial.	2010	88	Implementation may be required by 2005. Successful water demand management could delay the need for augmentation until 2014. Dams at Impendle and/or Smithfield are possible future options.

Notes:

1. See explanatory text in section 3.8.2.1.
2. Only schemes that may be required by or before 2025 are listed.
3. **The listing of an option does not imply any commitment to proceed with the development of the scheme, unless it is clearly stated as "approved".**
4. The name of dam site usually refers to the name of the farm on which the dam wall is to be situated.
5. Except where indicated, estimates of yield or increase in yield are current at February 2003 and are consistent with water availability figures elsewhere in the NWRS. They will be refined as necessary should work on the project be progressed.
6. Estimates of yield current at May 2004.

Table 3.8.3 (continued): Possible future large-scale water resource developments, primarily for domestic, urban, industrial or mining purposes

WMA	Name of dam site / scheme ⁴	River	Province	Use	Possible completion date	Estimated yield or increase in yield ⁵ (mill m ³ /a)	Comments
8	Klip River Dam	Klip River	Free State / Mpumalanga	Urban, industrial, power generation on the Eastern Highveld	2009	50	Transfers from Usutu-Mhlathuze WMA is an alternative and/or dam at Boekenhoutrand.
11	Dam at ISithundu	Mvoti	KwaZulu-Natal	Multi-purpose	2011	47	The Stanger area is experiencing water shortages. The dam will be required if other interventions do not provide a solution.
19	Berg River Project	Berg	Western Cape	Urban, industrial	2008	81	The dam has been approved for construction. Diversion from Molenaars River in Breede WMA is a possible further extension.
19	Voëlvlei Dam Augmentation	Berg	Western Cape	Urban, industrial	2015	30	Augmentation for West Coast and Greater Cape Town Metropolitan Area. Mitchells Pass Weir diversion to Voëlvlei is a possible future extension. Lourens River and Eerste River diversions and groundwater development are other alternatives being considered for future supply augmentation for the Greater Cape Town Area.
19	Table Mountain Group Aquifer	Berg and Breede	Western Cape	Urban, industrial	2016	70	Augmentation for Greater Cape Town Metropolitan area. Pre-feasibility study in progress.

Notes:

1. See explanatory text in section 3.8.2.1.
2. Only schemes that may be required by or before 2025 are listed.
3. **The listing of an option does not imply any commitment to proceed with the development of the scheme, unless it is clearly stated as "approved".**
4. The name of dam site usually refers to the name of the farm on which the dam wall is to be situated.
5. Except where indicated, estimates of yield or increase in yield are current at February 2003 and are consistent with water availability figures elsewhere in the NWRS. They will be refined as necessary should work on the project be progressed.

CHAPTER 3

PART 9 - FINANCIAL IMPLICATIONS

3.9.1 INTRODUCTION

Implementation of the strategies described in this First Edition of the National Water Resource Strategy (NWRS) will require extensive financial resources. The purpose of this part is to summarise the broad financial implications of the main activities required to implement the provisions of the National Water Act (the Act) and to indicate the arrangements for funding them.

All quoted costs and revenues, which must be regarded as indicative, are given at 2002 price levels unless otherwise indicated. They relate to costs that will be incurred by and revenues that will accrue to the Department and water management institutions as they progressively assume duties and responsibilities under the Act.

It is, however, acknowledged that individual users and water management and water services institutions will also incur costs in complying with the requirements of the Act. For instance, capital expenditure may be required to provide for activities such as the storage and transmission of water, investments in the treatment of waste or water containing waste before it is discharged into a water resource, the refurbishment or replacement of distribution systems as part of loss control programmes, and the purchase of water use entitlements to increase the economic efficiency of water use. Monitoring activities to comply with licence conditions may necessitate additional operational expenditure. The necessity for and magnitude of such expenditure has not yet been assessed.

Costs are grouped into two broad categories. First, the costs of operational activities relating to the protection, use, conservation, management and control of the nation's water resources, and, second, the capital costs of developing water resources infrastructure.

This part should be read in conjunction with Part 8 of this chapter, which discusses the anticipated programme for the activities for which indicative costs are provided.

3.9.2 OPERATING COSTS

Operating costs include the costs of all ongoing activities for the protection, use, conservation, management and control of the nation's water resources. Indicative costs are presented for the two broad groups of operational implementation activities, that is, routine activities and activities relating to commissioning or establishment, described in Part 8 of this chapter. It should be noted that many of the commissioning/establishment activities will extend into the next decade.

3.9.2.1 Routine operational activities

The total estimated annual funding requirement for routine operational activities is R 1 800 million.

This is R 200 million more than the Department's budget allocation for financial year 2002/3. The additional amount is needed to ensure that certain activities carried out under the Integrated Catchment Management component of the Water Trading Account (see below) - the development of catchment management strategies, the control of water use, water quality management, water conservation and water demand management, dam safety control and functional support to water management institutions - can be optimally carried out.

3.9.2.2 Commissioning/establishment activities

Whilst the cost of most of the routine operations described above are relatively easy to estimate in view of years of operational experience, commissioning/establishment activities have not previously been undertaken and the cost estimates for this group of activities must therefore be viewed as indicative at this stage.

Over the next 15 years, the estimated total cost of commissioning/establishment activities is expected to amount to approximately R 1 500 million, or about R 100 million a year on average. Further work will be done to obtain more exact estimates and cash flows.

As discussed in Part 8 of this chapter, commissioning/establishment activities include the introduction of compulsory licensing, the establishment of catchment management agencies, the delegation of operational responsibility for physical infrastructure (and, ultimately, the transfer of the ownership of infrastructure) to water management institutions, the establishment of new water user associations, the expansion of existing monitoring networks and information systems and establishment of new ones, the introduction of the water resource management charge, completion of the transformation of irrigation boards into water user associations, and dealing with the backlog of individual licence applications.

3.9.2.3 Total operating costs

The total annual operating costs are estimated to be R 1 900 million, comprising -

- Routine operating costs R1 800 million
- Commissioning/establishment costs R 100 million

3.9.3 CAPITAL COSTS

Estimates of capital expenditure for water resources management are currently limited to investments, described in Part 8 of this chapter, that may be required as publicly implemented projects serving multiple users during the next 20 to 25 years.

3.9.3.1 New government waterworks

Indicative costs for constructing the major schemes described in Part 8 of this chapter are presented in Table 3.9.1.

As shown, approximately R 20 988 million may be required for the development of major new government waterworks to be initiated during the next 25 years, as follows -

- Schemes primarily for irrigation purposes R 2 132 million
- Schemes primarily for urban, domestic, industrial or mining purposes R18 856 million

Because of the magnitude and importance of a scheme to transfer additional water into the Vaal River System the table also includes a provisional cost estimate for this project. Although present projections indicate that it is unlikely to be required before 2025 the scheme may have to be initiated during the current planning period.

Similarly, provision has been made for increasing the rate of transfer of water from the Thukela River into the Usutu to Mhlathuze water management area to provide for possible mining and industrial development, even though present projections indicate that it may not be required before 2025.

It must be emphasised that the inclusion of a scheme in the table only indicates that it has been investigated as a possible option to solve a problem of water availability. Inclusion implies neither a commitment to proceed with the scheme, nor that it is the

preferred option, nor that it is still viable, since circumstances may have changed since the investigation.

In all cases the estimates include the full costs of bulk storage and the costs associated with environmental and social impact mitigation but, unless indicated, exclude the costs of raw water transfer and conveyance works. Estimates exclude the costs of the “downstream” developments needed to use the water, such as the infrastructure required to treat the water, to pump or otherwise convey water to the point of use and, in the case of irrigation schemes, to prepare land.

Table 3.9.1: Indicative costs of major government water schemes

WMA	Name of dam / scheme ¹	River	Stage of Investigation ²	Indicative Cost ³ (R million)
Schemes primarily for irrigation purposes				
2	Tzaneen Dam raising and Dam at nWamitwa	Letaba	Feasibility	847
6	Dam at Embiane	Black Mfolozi	Pre - Reconnaissance	110
14	Dam at Vioolsdrif	Orange	Pre-feasibility	200
17	Clanwilliam Dam raising	Olifants	Pre-feasibility	160
17	Dam at Melkboom	Doring	Pre-feasibility	815
Sub-total				2 132
Schemes primarily for domestic, urban, industrial or mining purposes				
4	Flag Boshielo Dam raising	Olifants	Construction ⁴	270
4	Dam at De Hoop and bulk raw water conveyance infrastructure	Steelpoort	Feasibility	4 000
4	Dam at Rooipoort	Olifants	Feasibility	782
5	Dam at Mountain View	Kaap	Reconnaissance	381
5	Dam at Boekenhoutrand	Komati	Pre-Reconnaissance	691
7/6	Thukela-Mhlathuze Transfer ⁵	Thukela/ Mhlathuze	Pre-feasibility	339
7	Thukela Water Project ⁶	Thukela	Feasibility	6 736
7	Dam at Springgrove and aqueduct	Mooi	Feasibility	362
8	Klip River Dam	Klip River	Pre-feasibility	371
8	Vaal River Eastern Sub-System Augmentation (pipeline from Vaal Dam to Secunda)	Vaal	Feasibility	2 979
11	Dam at iSithundu	Mvoti	Feasibility	532
19	Berg River Project	Berg	Construction ⁴	1 188
19	Voelplei Dam Augmentation	Berg	Feasibility	225
Sub-total				18 856
Total				20 988

Notes:

- 1 The name of dam site usually refers to the name of the farm on which the dam wall is to be situated.
- 2, 3 Except for projects under construction (see Note 4) indicative costs (some of which were estimated some years ago) have been adjusted to 2003 levels. Confidence in the estimates depends on the stage of investigation as follows -
 - Pre-reconnaissance: The need for a project is identified and a number of options are investigated at a very low level of detail to select potentially feasible options
 - Reconnaissance: Potentially feasible options are studied at a low level of detail to identify feasible options and to determine the scope of further investigations.

- Pre-feasibility: Feasible options are studied in more detail to select one option for detailed investigation.
 - Feasibility: Detailed investigations, including extensive fieldwork, are carried out to confirm the technical, environmental, social, economic and financial viability of the selected option.
4. Indicative costs for schemes under construction are tender prices.
 5. Indicative costs are included for transferring water from the Thukela River into the Usutu to Mhlathuze water management area for possible mining and industrial development in the Richards Bay area.
 6. The Thukela Water Project is included to represent the indicative costs of a transfer scheme to bring additional water into the Upper Vaal Water Management Area. This could also be achieved via Phase 2 of the Lesotho Highlands Water Project, or by transferring water from the Upper Orange River.

3.9.3.2 Expansion of national monitoring networks

Capital expenditure on infrastructure development will also be required to expand national monitoring systems, as described in Part 7 of this chapter.

Using present monitoring technologies, the capital expenditure required to expand the network to optimum levels may be as high as R1 300 million over the next 20 to 25 years, or about R60 million a year. (Provisions for this purpose in the allocation for 2002/3 amounted to only about R 2 million).

3.9.3.3 Other capital expenditure

Capital expenditure is also required for refurbishment works (betterments) on existing government water schemes, the redemption of existing loans, financial assistance to statutory bodies (transfer payments) and movable assets such as computer and monitoring equipment.

It is estimated that approximately R 530 million a year will be required for these activities for the foreseeable future, equal to the allocation in 2002/3.

3.9.3.4 Total capital costs

Total estimated capital expenditure over the next 20 to 25 years could therefore amount to a total of approximately R1 430 per year, as follows -

- Major new government waterworks	R 20 988 million	Av. ±R 840 million a year
- Expansion of national monitoring networks	R 1 300 million	Av. ±R 60 million a year
- Other capital items		R 530 million a year

3.9.4 EXISTING FUNDING

At present the Department's water resources management activities are mainly funded from two sources: allocations from the government's Exchequer Account; and revenue from the sale of water via the Water Trading Account. The Department also benefits from some international donor funding.

3.9.4.1 Revenues from water use charges - the Water Trading Account

The Department recovers revenue from water use charges made in terms of the water pricing strategy via its Water Trading Account. The intention is to recover all costs incurred, but the Water Trading Account currently operates at a loss. The deficit is made good by an augmentation allocation from the Exchequer Account.

The Department will continue to operate the Water Trading Account until such time as water management institutions - catchment management agencies, water user associations and any

future infrastructure management agency or agencies that may be established - are empowered to collect revenue from water users in terms of the pricing strategy.

The Water Services component of the Trading Account is concerned with schemes that supply water mainly for domestic use. It is scheduled to be closed in 2005/6 following the transfer of water services schemes to local government in terms of the Division of Revenue Act, 2002, and is not discussed here.

3.9.4.2 Donor funding

From time to time other countries assist the Department by providing donor funding. Usually this is provided to finance specific projects. Some donors have made multi-year commitments. The Department is regularly involved in negotiations for assistance with international partners, but the amount of donor funding has been declining in recent years and this trend can be expected to continue. The exception may, however, be in respect of co-operative programmes of regional scope that support the global public goods such as the protection of biodiversity and hydrological monitoring.

3.9.5 FUTURE FUNDING ARRANGEMENTS

During the next 10 to 15 years the majority of the Department's operational and development responsibilities will be delegated or assigned to water management institutions. These institutional changes will profoundly affect the Department's funding requirements and revenue streams.

3.9.5.1 Operational activities

The progressive transfer of water resources management responsibilities to catchment management agencies will include the transfer of all costs and revenues associated with the Integrated Catchment Management component of the Water Trading Account. This component currently runs at a deficit. Similarly, the progressive transfer of operation and maintenance responsibilities for irrigation schemes to water user associations will include the transfer of all costs and revenues associated with the Bulk Water Supply component. This component also runs at a deficit.

Water use charges in terms of the water pricing strategy will improve revenue streams with time by progressively introducing tariffs that more closely reflect the actual costs of water resources management activities, and broadening the user base from which financial contributions are drawn. The Department introduced water resources management charges in terms of the water pricing strategy in 2002 and will continue to implement the strategy in a phased manner. Vigorous efforts will be made to improve and sustain the level of revenue collection so that there will eventually be no need for allocations from the Exchequer to augment revenue.

The Department will support water management institutions as they take over the responsibility for revenue collection. Nevertheless, until such time as water management institutions become financially self-sufficient provision will be made for Exchequer funding to cover deficits.

The processes of establishing and developing catchment management agencies and compulsory licensing will require ongoing Exchequer allocations, an investment in the development of institutional self-sufficiency in water resources management.

The duration and extent of continuing financial support for water management institutions will become clear as the Department gains experience through pilot implementation processes. The objective is, however, to implement the activities described in the Strategy without any substantial increases in Exchequer funding.

3.9.5.2 Infrastructure development

In terms of national policy, the majority of infrastructure development required to support economic activity should be funded off-budget through payments by users. One of the objectives of the current review of arrangements for developing and managing water-related infrastructure is to make recommendations for a coherent approach to the financing of capital investments. The establishment of a national water resources infrastructure agency or a number of regional agencies (see Part 5 of this chapter) could significantly reduce the need for direct government expenditure on capital works by facilitating off-budget funding flows.

The review is also investigating funding mechanisms for investments where long payback times or financially weak consumers do not make it possible for a project finance approach to be adopted. Some government funding may continue to be required for the development of schemes of this nature, intended primarily for irrigation, social, disaster mitigation or environmental purposes, or to meet international obligations. Exchequer funding will also continue to be required for the capital costs of expanding the monitoring network.

If all the irrigation-orientated schemes identified in Table 3.9.1, as well as the structures required to expand the monitoring network, are built in the next 20 to 25 years, and if none of these are financed off-budget, the average annual capital funding requirement from the Exchequer will amount to around R145 million; R85 million for water supply schemes and R60 million for monitoring infrastructure.

If a water resources infrastructure agency is established it should be possible to implement a self-funded programme aimed at developing the required infrastructure. However, if a separate organisational entity is established within the Department for the development and management of major infrastructure new projects and capital expenditure will have to be funded directly from the Exchequer under the present financial management arrangements. If all the schemes identified in Table 3.9.1 as being primarily for domestic, urban, industrial and mining purposes are built in the next 25 years, the average annual capital funding requirement would be R755 million.

It should be noted that a substantial proportion of capital investment in the past decade has been financed off budget from sources other than the National Treasury. These include the following -

- The water transfer component of the Lesotho Highlands Water Project was financed by loans arranged by the project authorities and managed by the Trans-Caledon Tunnel Authority, the statutory body established for this purpose. The Authority also undertook the construction of the delivery tunnel from Lesotho into South Africa and associated infrastructure in South Africa. The loans, which are guaranteed by the South African government, are serviced from charges made by the Department on water users in the Vaal System and remitted to the Authority.
- The Trans-Caledon Tunnel Authority, acting as an agent for the Department and the City of Cape Town, is responsible for raising the finance for the construction of the recently approved Berg River Project in the Western Cape Province, including a dam on the farm Skuifraam^[1]. Loans for the project will not be guaranteed by the government.
- The Komati Basin Water Authority was responsible for arranging finance for and undertaking the construction of water resources infrastructure in the Komati River Basin in South Africa and Swaziland, and is now responsible for servicing the loans from grants (subventions) received from the governments of Swaziland and South Africa.
- Dam development in the Usutu River to facilitate power generation and current projects to increase the transmission capacity of the system are largely financed by the principal user, Eskom.
- Similar arrangements with mining interests have been put in place to finance the raising of the Flag Boshielo Dam on the Olifants River (north).

Similar arrangements will not necessarily be possible for other projects scheduled to be built within this First Edition NWRS review period, and a substantial increase in Exchequer funding may be required for the projects if institutional restructuring is not undertaken.

3.9.6 CONCLUSION

From the above it appears that the Act's provisions can be implemented within the existing financial framework. The future size of the Exchequer allocation will depend on the Department's success in raising and maintaining the level of payments for water in terms of the national water pricing strategy, and on it being allowed to retain existing Exchequer allocations and revenue from water use charges to finance commissioning/ establishment activities.

The initial review suggests that the requirement for capital expenditure on new government waterworks could average approximately R900 million a year. A large proportion of this amount could be funded off budget if institutional restructuring is implemented. Should this not occur, the Exchequer's allocations for major capital investments may have to be increased.

Note to Chapter 3, Part 9

¹ In addition to the financing arrangements TCTA is also responsible for the implementation of the Berg Water Project, including engineering, construction, environmental (natural and social) and communications issues.

CHAPTER 4 - COMPLEMENTARY STRATEGIES

4.1 INTRODUCTION

This chapter gives brief descriptions of strategies for -

- **Building capacity and expertise among practitioners in the water sector:** A programme for the water sector in which the Department is playing a leading role in partnership with other role players in the sector.
- **Educating and creating awareness among stakeholders:** Departmental programmes of public consultation, communications and education.
- **Water research:** Water research is commissioned and co-ordinated by the Water Research Commission in close liaison with the Department and other role players in the water sector.

Whilst most of these activities are not specifically required by the Act, they are nonetheless essential for its long-term, sustained implementation. The approaches to capacity building in the water sector, and educating and creating awareness among stakeholders are described at national level, recognising that they will need to be implemented at catchment and local levels in partnership with other government departments and the private sector.

4.2 CAPACITY BUILDING IN THE WATER SECTOR

Strategies to give effect to the provisions of the National Water Act (the Act) will not be effective if there are too few competent people available to implement them.

One reason that the implementation of the Act will take place progressively over time is that South Africa's financial and human resources are, at present inadequate to implement all of its provisions at once across the country. It is imperative to ensure that sufficient capacity is created in the water sector to implement and sustain the implementation of water policy and legislation.

Water resources management is a relatively specialised activity that, as a result of the changes introduced by the Act, now requires competencies in a wider range of disciplines than was previously the case. The training, re-training and development of the potential of people who currently work or will in future work at all levels of all organisations and agencies involved in the water sector is recognised in the National Water Policy as being a critical determinant for the achievement of wise and efficient water resources management in South Africa.

A Water Sector Capacity Building Strategy Task Team has been established to develop a capacity building strategy for the water sector. The Department is playing a prominent role in this initiative. The strategy has the objective of ensuring that, in some reasonable and achievable time frame - a period of 15 years has been suggested - all role players in the South African water sector, including the Local Government and Water Sector Education and Training Authority, will have ensured that the necessary capacity exists in all relevant institutions to fully implement water-related policy and law.

The task team's efforts will centre on meeting the competency needs of the sector. The focus will be on people: the creation and development of the skills, knowledge and attitudes required to support the development of the infrastructure, institutions, knowledge and information management, and financial management necessary to undertake water resources management. There have already been encouraging developments in this regard, with new, specialised courses being offered at post-graduate level at a number of tertiary institutions. The development of high-level post-graduate skills will continue to be supported by the Water Research Commission (see below). In addition, the National Water and Sanitation Training Institute at the University of the North provides a variety of short courses at a range of levels.

Furthermore, in line with the general requirement for national social and economic transformation, all capacity building initiatives must address representivity in terms of race, gender and disability in all water sector institutions. The Department's bursary policy, aimed at assisting students with their studies in selected fields, will continue to focus on achieving improved representivity in the technical disciplines.

An important component of the capacity building strategy will be the promotion of networking among education and training service providers and users. Steps have already been taken in this direction with the development of the Framework Programme for Education and Training in Water^[1], which will provide institutional support and seed funding to encourage the creation of networks to promote effective co-operation between universities, research institutions, and the public and private sectors.

The water sector capacity building strategy will be consistent with capacity building initiatives in other sectors of society via the legislative, institutional and financial framework provided by the South African Qualifications Authority Act, 1995, the Skills Development Act, 1998, and the Skills Development Levies Act, 1999.

4.3 PUBLIC CONSULTATION, EDUCATION AND AWARENESS CREATION

4.3.1 Public consultation

There are a number of sections in the Act^{[[2]} that require formal public consultation on proposed initiatives to implement the Act's provisions. All comments received in response must be taken into consideration.

One of the Act's main objectives is to progressively decentralise the responsibility for water resources management from national to regional institutions, the principal institutions being catchment management agencies (see Part 5 of Chapter 3). These agencies must promote participation by water users and other stakeholders in all aspects of water resources management in their areas of operation.

For water users and stakeholders to effectively contribute to water resources management they need to be aware of the issues and difficulties, and have an understanding of what is required. However, while some water users and stakeholders are often very well informed, others, particularly in poorer, historically disadvantaged communities, may not be able to participate effectively in consultation procedures without additional support. A comprehensive stakeholder analysis, aimed at determining the capacity of users and stakeholders to participate, is therefore a key part of any consultation programme.

The Department will continue to undertake public consultation exercises in a way that enables all stakeholders, particularly those from previously disadvantaged backgrounds, to participate effectively. Help will be offered to ensure that they understand the issues under discussion, and can participate in an informed and meaningful way.

The Department is aware of the danger of stakeholders becoming overloaded by the number and complexity of issues on which they may be consulted. For this reason it is important to encourage the establishment of representative stakeholder groups in each water management area as a focus for all consultation exercises. Non-statutory forums (see Part 5 of Chapter 3) can play an important role in this respect.

The Department has developed guidelines for public participation in water-related issues to ensure a consistent approach throughout the country. It is anticipated that all water management institutions will adopt these guidelines for their consultative processes.

4.3.2 The Water Education Programme

The departmental Water Education Programme (formerly known as the 20/20 Vision for Water Programme) aims to raise awareness among South Africans of water as a scarce and precious resource, and to develop responsible attitudes towards its use and conservation. It has the following objectives -

- Raising the level of understanding of water issues - water literacy - throughout the country.
- Promoting resource conservation among the public.
- Integrating water-related education into the formal curricula of all educational institutions.
- Integrating environmental education into all departmental programmes.
- Establishing partnerships with all stakeholders in the water sector at national and international levels and developing collaborative networks.

Since its inception in 1996 the programme has reached more than 10 000 schools and it is planned to expand its activities to tertiary learning institutions. Learners in schools develop water values and life skills by carrying out projects to investigate how water is used, how waste can be prevented and how to determine if water is fit for human consumption. They are encouraged to share their knowledge and understanding in their communities. The programme works closely with provincial education and environmental authorities to ensure consistency of application and integration with the outcomes-based education system.

4.3.3 Communication

Important sources of information about the Department's intentions and achievements are the Three Year Strategic Plan and the Annual Report, both prepared and published annually in accordance with the requirements of the Public Finance Management Act, 1999.

In addition to these and the formal consultation exercises described above the Department will continue with its extensive communications programme aimed at providing the public with information about the Minister's and the Department's activities, gathering information about public concerns with regard to water and forestry, and obtaining feedback on the Department's performance. Some of the more important initiatives under the programme include the following -

- Community visits - *imbizos* - by the Minister and departmental staff to water schemes and projects. These *ad hoc* visits occur in addition to the regular *imbizos* arranged as part of a government programme.
- Ensuring media coverage of the Minister's budget debates in the National Assembly and the National Council of Provinces. Achievements against legislative mandates and priorities for the future are covered in these debates.
- Regular media briefings by the Minister, including parliamentary media briefings.
- Water Week, celebrated in March of each year, in which topical themes are publicised in the media and at open days at departmental offices throughout the country.
- Publicity, in the form of editorials, advertisements and supplements in the print and electronic media, on water schemes, projects and programmes.

4.4 WATER RESEARCH

The importance of research to water resources management cannot be over-emphasised. Research has been fundamental to understanding South Africa's water resources and has contributed to the development of many of the techniques and tools used for their management. Many of the innovative and internationally applauded provisions in the Act - notably in respect of resource protection - were based on the results of South African research. New challenges in the water sector arise continually and require new understanding and new tools and techniques. To meet these challenges, the Water Research Commission (WRC), a statutory body funded by

a levy on water use, will continue to ensure that the strategic direction of water research in South Africa is attuned to the country's needs.

The WRC is the co-ordinator of water-related research and development in South Africa. Through its funding and networking activities it encourages the development of water-related knowledge and facilitates its dissemination and application. The WRC maintains close ties with the Department and regular liaison and co-ordination meetings between the two organisations ensure that the Department's research needs are known. The Department of Science and Technology and the National Research Foundation are partners with the Department and the WRC in ensuring that approaches to water research are consistent with South Africa's broad policy on science and innovation.

The WRC's approach is to invest in research and development through four water-centred key strategic areas as follows -

- **Water Resource Management**, an integrating key strategic area that considers issues of equity and sustainability in the management of water resources.
- **Water-Linked Ecosystems**, which addresses the protection of water resources.
- **Water Use (Industrial and Domestic) and Waste Management**.
- **Sustainable Water Use for Agriculture**, which address the sustainable use of water in their respective user sectors.

The WRC also invests in the transfer, dissemination and application of knowledge through a fifth key strategic area, **Water-Centred Knowledge**, an integrating key strategic area that addresses the mechanisms needed to ensure the effective dissemination of research results and products to water resources managers and other prospective users in an effective format.

To ensure that research results are also relevant to the broader objectives of water resource management: the relevance and applicability of research in each key strategic area are maximised by addressing the relationships between: water and society; water and the economy; water and health; and water and the environment.

A key crosscutting objective of the WRC is to support the development of human resources in the water sector. Involvement in research is recognised as an important vehicle for building and developing expertise among water resource practitioners. Every research project is therefore required to incorporate a strong element of capacity building, especially among previously disadvantaged individuals. The objective will be to ensure that, at least until 2009, every member of a previously disadvantaged group who qualifies and wishes to do so should be able to obtain sponsorship for post-graduate study through research.

A review will be undertaken of the legislation governing the WRC to ensure consistency with the Public Finance Management Act, as well as the evolving framework for the governance of public institutions in general and publicly funded research in particular.

Notes to Chapter 4

¹ A joint initiative of the Department and the Water Research Commission in collaboration with the United Nations Education, Science and Cultural Organisation and the Flemish Government.

² Requirement to consult: In all cases listed below except in respect of sections 10 and 41 the Act requires that a Notice is published in the *Gazette*, and that other appropriate steps are considered to bring the notice to the attention of interested persons.

Section of the Act	Subject of consultation	Who must consult	With whom
5	Establishment of the National Water Resource Strategy	The Minister	Interested persons
8	Establishment of a Catchment Management Strategy	A catchment management agency	Interested persons
10	Development of a Catchment Management Strategy	A catchment management agency	The Minister, organs of State, interested persons
13	Determination of the class of a water resource and resource quality objectives	The Minister	Interested persons
16	Determination of the Reserve	The Minister	Interested persons
36	Declaration of stream flow reduction activities	The Minister	Interested persons
38	Declaration of controlled activities	The Minister	Interested persons
39	Issuing a general authorisation to use water	A responsible authority	Interested persons
41	A licence application	The applicant	Relevant organs of state, interested persons, the general public
43	Requirement to apply for a licence in terms of a compulsory licensing exercise	A responsible authority	Interested persons
45	A proposed allocation schedule	A responsible authority	Interested persons
56	Establishment of a pricing strategy for water use charges	The Minister	Interested persons
69	Making regulations	The Minister	Interested persons
Regulations must also be tabled in the National Assembly and the National Council of Provinces			
78	Establishment of a catchment management agency, changing its name or its area of jurisdiction	The Minister	Interested persons
88	Disestablishment of a catchment management agency	The Minister	Interested persons
92	The establishment of a water user association (except if there has been sufficient consultation in preparing a submission to establish the association)	The Minister	Interested persons.
96	Disestablishment of a water user association	The Minister	Interested persons
110	A proposal to construct a government waterwork (except in emergency circumstances, and for temporary or minor waterworks)	The Minister	Interested persons
Schedule 3, Item 3	Making rules to regulate water use	A catchment management agency	Interested persons

CHAPTER 5

NATIONAL PLANNING AND CO-ORDINATION, AND INTERNATIONAL CO-OPERATION IN WATER MANAGEMENT

(Section 6 of the National Water Act requires the strategies, objectives, plans, guidelines and procedures, and institutional arrangements described in the National Water Resource Strategy to be within the framework of existing relevant Government policy and to support the achievement of certain compulsory standards prescribed under the Water Services Act.

Section 6 also requires the National Water Resource Strategy to provide for international rights and obligations.

Section 9 requires catchment management strategies to take account of national or regional plans prepared in terms of any other law, particularly development plans prepared in terms of the Water Services Act.

Section 22 provides for responsible authorities to promote arrangements with other organs of state to combine their respective licence requirements into a single licence requirement.

Section 81 requires representation from provincial and local government on the governing boards of catchment management agencies.

Section 138 requires the Minister of Water Affairs and Forestry to establish mechanisms and procedures to co-ordinate the monitoring of water resources after consulting with, among others, relevant organs of state).

5.1 INTRODUCTION

This chapter describes some of the principal relationships between the National Water Act (the Act) and other national laws, policies, strategies and programmes, and the co-operative relationships needed to implement the National Water Resource Strategy (the NWRS). South Africa's international relationships in water matters are also discussed.

5.2 THE FRAMEWORK OF EXISTING RELEVANT GOVERNMENT POLICY

The law that directly relates to water is consolidated into two major acts - the Water Services Act, 1997 and the National Water Act, 1998. The Water Services Act provides the regulatory framework for the provision of water services by local authorities, under the overall oversight of the Minister of Water Affairs and Forestry (the Minister). The Act mandates the Department of Water Affairs and Forestry (the Department) to ensure that all activities relating to water resources management, by whoever they are undertaken, are in accordance with the requirements of the Act. There are, however, many other laws that govern activities that are dependent on water, or which affect water resources. These laws are administered by a number of departments in all spheres of government^[1].

The Department, in accordance with the Constitution, is committed to co-operating with all spheres of government to achieve the national objectives of equitable and sustainable social and economic development. However, departments cannot co-operate effectively if the policies and laws they administer are in conflict with one another. Accordingly section 6(1)(a) of the Act (see Appendix C) requires, among other things, that the Department's strategies and institutional arrangements for water resources management are "within the framework of existing relevant Government policy". In preparing the NWRS the Department examined a number of national policies and laws to determine the extent to which the strategies, objectives, plans, guidelines and procedures, and institutional arrangements proposed in the Strategy are in harmony with the Act's requirement.

The policies and laws examined related to environmental management, coastal management, agriculture, the development and use of land, minerals, mining and energy, waste management,

spatial development, housing, health, rural development and urban renewal, disaster management, and local government development. Provincial planning and development legislation was also considered, together with many provincial development strategies as were available.

In general terms no fundamental conflicts were identified between the proposals in the NWRS for implementing the provisions of the Act and the policies and laws examined. However, it is evident that policy, legislation and development planning do not always take the availability of water into account and that there is an assumption that water can always be made available for any development initiative.

The Department will continue to foster co-operative relationships with relevant departments in all spheres of government to ensure that the NWA is implemented in harmony with their mandates. (See also the discussion on integrated water resources management in Chapter 1)

5.3 SPECIFIC REQUIREMENTS OF OTHER NATIONAL LEGISLATION

A number of national laws impose specific requirements on the Department and the water management institutions established in terms of the Act as they carry out their mandates in respect of water resources management.

5.3.1 The Water Services Act, 1997 (No. 108 of 1997) (WSA)

5.3.1.1 Alignment of water resources management and water services provision activities

During the process of reviewing the Department's organisational structure (see Part 5 of Chapter 3), a number of interfaces were identified between water resources management and water services provision where streamlining and integration are required, as follows:

Strategy and planning: Aligning strategies and planning for water resources management and the provision of water services, particularly in respect of the links between the catchment management strategies required by the Act and the water services development plans required by the WSA.

Water use regulation: Co-ordinating the common regulatory and audit functions for water resources management and water services, including monitoring and managing compliance with the conditions of water use.

Implementation: Promoting partnerships for developing and managing water resources infrastructure, and implementing interventions in, for instance, water quality management and water demand management.

Institutional support: Sharing capacity for empowering, co-ordinating and supporting water management and water services institutions, and transferring functions to them.

Information management and communications: Integrating or linking information systems and technology, and co-ordinating communication with external stakeholders and partners.

Furthermore, the Act contains specific requirements for water resources management activities to support the provision of water services. These are discussed below.

5.3.1.2 Water services development plans

Section 9 of the Act requires catchment management strategies to take account of the development plans prepared in terms of the WSA. All metropolitan and district municipalities, all of which are designated as water services authorities, and any local municipalities authorised to fulfil the role of a water services authority, must prepare water services development plans in terms of the WSA. These plans form part of the Integrated Development Plans that municipalities must prepare in terms of the Municipal Systems Act, 2000 (No. 32 of 2000).

A water services development plan will be a responsible authority's (see Part 5 of Chapter 3) principal source of information for determining water allocations to a municipality and issuing a licence (see Part 2 of Chapter 3). The plan's requirements must be accounted for in the responsible authority's catchment management strategy. Some of the data in water services development plans will be incorporated into the national water resources information system (see Part 6 of Chapter 3) and will therefore contribute to national water resources planning. The plans should also contain details of water demand management and conservation measures (see Part 4 of Chapter 3) and contingency plans for water-related disasters (see Part 7 of Chapter 3).

For its part, when preparing its water services development plan, a water services authority must refer to the relevant catchment management strategy for information about the availability of water to support proposed water services targets, the source of the water, and the requirements for the quality of waste water that is to be returned to the water resource after use.

5.3.1.3 Regulations under the Water Services Act

Section 6(1)(a)(ii) of the NWA requires the strategies in the NWRS to support the achievement of compulsory national standards prescribed under section 9(1) of the WSA. The Regulations prescribe standards for a range of water services issues^[2]. The main relationships between the regulations and requirements for water resources management are as follows -

- **Basic sanitation:** The design of sanitation facilities must take account of the potential for polluting water resources, especially with regard to groundwater.
- **Basic water supply:** Basic human needs are included in the Reserve described in the NWRS.
- **Quality of potable water:** The quality of water in rivers, dams and groundwater aquifers has a direct impact on the costs incurred by water services institutions when treating water to prescribed standards.
- **Control of objectionable substances and disposal of grey water:** The Act provides for the establishment of standards for the discharge of waste or water containing waste into a water resource by regulation, and provides for the inclusion of these standards in the conditions attached to licences and general authorisations.
- **Use of effluent:** The use of effluent for irrigation or to recharge a groundwater aquifer are controlled activities under section 37 of the Act and must be authorised by a responsible authority.
- **Quantity and quality of industrial effluent discharged into a sewerage system:** The capacity of sewage treatment works to meet their licence conditions under the Act will influence the type of effluent the water services institution can accept into its sewers.
- **Water services audit, water and effluent balance analysis and the determination of water losses; the repair of leaks; measurement or control of water supplied; pressure in reticulation system; and reporting of non-compliance:** These relate to the requirements of the water conservation and water demand management strategy for the domestic sector.

5.3.1.4 Water services tariffs

Section 56 of the Act requires that the pricing strategy for water use charges supports the establishment of tariffs by water services authorities. The relationship between the national water pricing strategy and the establishment of tariffs under the Water Services Act is discussed in Part 4 of Chapter 3.

5.3.2 Environmental legislation

Water resources management is subject to the requirements of national environmental legislation as contained in the National Environmental Management Act, 1998 (No. 107 of 1998)

(NEMA) and those parts of the Environment Conservation Act, 1989 (No. 73 of 1989) (ECA) that have not yet been repealed by NEMA.

NEMA defines the Department as a national department that exercises functions that may affect and which involve the management of the environment. Regulations made in terms of ECA define activities that may have a substantial detrimental effect on the environment. These include most of the water-related activities for which the Department is currently responsible under the Act. The Department is therefore obliged not only to ensure that all activities related to the management of water resources are carried out in accordance with the requirements of the Act, but also that they comply with the requirements of NEMA, ECA and other related environmental legislation.

5.3.2.1 Consolidated environmental implementation and management plan

In terms of NEMA, the Department has prepared and published a Consolidated Environmental Implementation and Management Plan (CEIMP) that describes, among other things, the Department's functions, policies, plans and programmes, and how these comply with environmental legislation. The plan also describes existing and proposed co-operative arrangements with other departments in all spheres of government that will ensure their compliance with water-related policy and legislation. The CEIMP must be reviewed and revised as necessary at least every four years, and annual progress reports must be submitted to the Department of Environmental Affairs and Tourism (DEAT).

Other departments (listed in Schedules 1 and 2 of NEMA) must also prepare Environmental Implementation and/or Environmental Management Plans. All plans must be assessed by the Committee for Environmental Co-ordination, of which the Department's Director-General is a member, to ensure that they comply with environmental legislation and are in harmony with one another. The plans are therefore important tools for promoting a consistent and co-operative approach to environmental management.

5.3.2.2 Integrated environmental management framework

In its CEIMP the Department has committed itself to developing and implementing an integrated environmental management framework to ensure that its approach to environmental issues is aligned with the national environmental principles described in NEMA, and complies with the requirements of NEMA and the Act. In particular, the framework will ensure that environmental considerations are addressed throughout the life cycle of all water-related projects and activities at both strategic and project levels. A range of appropriate environmental assessment and management tools, such as strategic environmental assessment, biophysical, social and health impact assessment, risk analysis and environmental management plans, will be developed and implemented to facilitate sound environmental practices.

5.3.2.3 Environmental reporting

NEMA requires DEAT to prepare an Annual Performance Report on Sustainable Development in terms of government's commitment to Agenda 21, the United Nations' plan of action to achieve sustainable development that was agreed at the 1992 Earth Summit in Rio de Janeiro. As part of this commitment DEAT also intends producing regular State of the Environment Reports for South Africa. The first edition was published in 1999.

The Department's contributions to national environmental reporting will be co-ordinated through the integrated environmental management framework and will be facilitated by the preparation of regular State of Water Resources Reports. These reports will include information that will highlight progress in achieving the environmental objectives of the Act. The reports will indicate areas where new interventions or intensified efforts are required, and thus inform the content of subsequent editions of the NWRS.

5.3.2.4 Management of waste disposed onto land

By agreement with DEAT the Department has a mandate in terms of section 20 of the ECA to oversee the management of waste disposal onto land. The Minister is responsible for issuing permits for waste disposal sites and for issuing directives concerning the management of the sites. However, Parliament has approved an amendment to the ECA that transfers this responsibility to DEAT. The transfer of the function will take place according to a timeframe agreed between the departments, with the intention of effecting the transfer by April 2005. The Department will retain responsibility for reviewing permits.

5.3.3 National disaster management legislation

The National Disaster Management Act (No. 57 Of 2002) was promulgated in January 2003. (see Part 7 of Chapter 3). The Department's obligations in terms of the new legislation are expected to be as follows -

- To support the Minister's participation in the Inter-Governmental Committee on Disaster Management.
- To represent the Department on the National Disaster Management Advisory Forum. A senior departmental official will be the official representative at national level for all water-related disaster management issues.
- To contribute to the development of the National Disaster Management Framework. The Department will take the lead in developing the component of the framework that deals with floods caused either by extreme, naturally occurring rainfall events, or by dam failures, and will also play a key co-ordinating role in implementing the flood policy. The Department will also contribute to the development of other components of the framework, notably those dealing with droughts, environmental emergencies, epidemics, veld and forest fires, weather warnings, international aspects and urgent responses.
- To provide relevant information to the National Disaster Management Centre's information system. It is expected that most of the water-related information required for emergency and disaster management will progressively become available on the Department's information system, which must be linked with that of the Centre. The Department has played a leading role in the development of information systems at the Centre and routinely makes information available to the system.
- To prepare a departmental disaster management plan on water-related matters, ensuring that catchment management strategies and the business plans of water user associations include disaster management planning, and that contingency plans for water-related disasters are included in all Water Services Development Plans and business plans prepared by water services authorities and institutions.
- To co-ordinate the water sector's representation on forums established to identify disaster-related priorities and requirements for development at national, provincial and local levels.
- To ensure regional interactions, co-ordinated through the Southern African Development Community Water Sector, with neighbouring countries in internationally shared river basins.

5.3.4 Public Finance Management Act (No. 29 of 1999)

The Department is subject to all relevant provisions of the Public Finance Management Act, 1999 (PFMA) and its associated Treasury Regulations. In addition to requirements relating to financial and asset management, the Department has important reporting obligations in terms of the PFMA, as follows -

- The Department must prepare a Strategic Plan containing details of its functional intentions and financial provisions for a three-year period. The plan must be updated annually.
- The Department must submit quarterly progress reports to the Minister and Annual Reports to the National Treasury detailing its performance against the intentions set out in the Strategic Plan.

The Department will ensure that the Strategic Plan and the NWRS are closely aligned to each other.

In discussions with the National Treasury the Department will clarify the status of catchment management agencies and water user associations under the PFMA, and the extent to which they will be subject to the requirements of the PFMA

5.3.5 Promotion of Access to Information Act (No. 3 of 2000)

The Department has responsibilities under the Act to make water-related information available to the public, particularly in respect of actual or potential disasters and emergency situations (see Part 7 of Chapter 3).

The Promotion of Access to Information Act, 2000 (PAIA) gives effect to the constitutional right of access to any information held by the Department that is required for the protection of any rights. Section 15 enables the Department to make certain information available automatically without a person having to request access in terms of the PAIA. The Department will define and declare such information, which is expected to include the greater part of water-related information.

All relevant provisions of the PAIA will apply to catchment management agencies and water user associations.

5.3.6 Promotion of Administrative Justice Act (No. 2 of 2000)

The Act provides the right of appeal to the Water Tribunal, but the matters on which an appeal can be made are limited to those specified in the Act (see Part 5 of Chapter 3).

The Promotion of Administrative Justice Act, 2000 (PAJA) applies to all administrative actions and reinforces the necessity for water resource managers to apply their minds to every aspect of the decision-making process and to ensure that every relevant aspect is taken into consideration. Alleged breaches of administrative procedures that are beyond the scope of the Act will be adjudicated by the courts, and not by the Water Tribunal.

All relevant provisions of the PAJA will apply to catchment management agencies and water user associations.

5.4 INTER-GOVERNMENTAL PLANNING

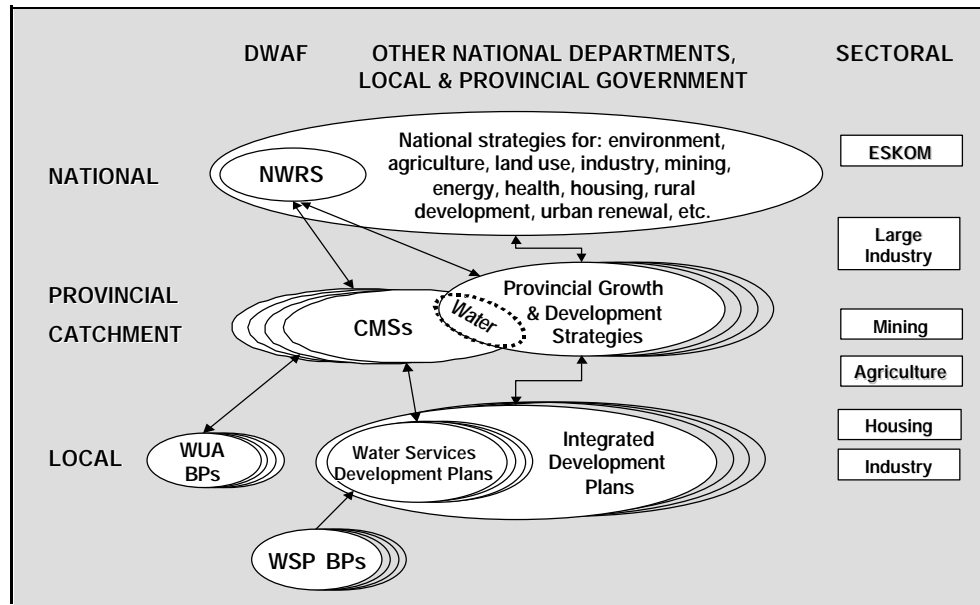
The Constitution provides for three spheres of government - national, provincial and local - which are "distinctive, inter-dependent and inter-related". Whilst each sphere of government is responsible for planning the activities for which it is constitutionally mandated, the activities and the plans and strategies that guide them must be aligned one another and with those of other spheres of government. This alignment is achieved within the inter-governmental planning system, in which there is mutual co-operation and sharing of information. In particular, provincial and local governments must have the opportunity to participate in the development of national plans and strategies, and in making decisions that will affect their areas of jurisdiction. Accordingly –

- National government provides a framework of common policies and principles, and co-ordinated and prioritised programmes, within which provincial, municipal and sectoral planning can take place;
- Provincial growth and development strategies provide a more specific framework for the development of projects and programmes on a provincial level, as well as the co-ordination of sectoral and municipal planning; and
- Under the Municipal Systems Act, 2000 district municipalities are required to prepare five-year Integrated Development Plans to guide and inform all aspects of planning, implementing

and managing service provision in their areas. The plans must be compatible with national policy and legislation and be aligned with provincial strategies and plans.

Fig. 5.1 illustrates in broad terms the links between the strategies and plans for water resources management and water services provision, and the strategies and plans of other national, provincial, municipal and sectoral interests.

Fig 5.1: Water-related planning in the national planning framework



CMS - catchment management strategy; WUA - water user association; WSP - water services provider; BP - business plan.

5.5 NATIONAL PROGRAMMES

To increase the focus on the development of rural and urban communities, two national programmes have recently been launched to integrate relevant programmes in all spheres of government.

5.5.1 The Integrated Rural Development Programme

The Integrated Rural Development Programme was launched by the Office of the Presidency in 2000 with the aim of facilitating the provision of improved opportunities for the rural poor. The vision of the programme is to "*attain socially cohesive and stable rural communities with viable institutions, sustainable economies and universal access to social amenities, able to attract and retain skilled and knowledgeable people, who are equipped to contribute to growth and development.*" Local government will play the central role in implementing this programme. It will initially be implemented in selected pilot areas and will subsequently be expanded to cover the entire country. The programme is co-ordinated by the Department of Provincial and Local Government.

The availability of water is one of the key factors in rural development. The provision of basic water services is essential, but water resources management strategies will also be developed and implemented with a view to promoting rural development, particularly poverty eradication. The Department is co-operating with other government departments to ensure that the management of water resources can contribute to the programme's aims. Activities and interventions include the following -

- Modifying water resources management programmes and priorities, as required, to account for the priority areas identified in the programme.
- Ensuring that rural development features strongly in catchment management strategies.
- Identifying rural water needs and opportunities, with specific allowance being made for rural development and the improvement of social conditions and livelihoods when water is re-allocated by compulsory licensing. Particular attention will be paid to identifying potential rural users, in addition to registered users, when licence applications are called for during the compulsory licensing process.
- Ensuring that communities are represented on the management bodies of water management institutions.
- Ensuring that communications, awareness creation and education programmes are appropriate for rural communities.

5.5.2 The Urban Renewal Strategy

The Urban Renewal Strategy is also co-ordinated by the Department of Provincial and Local Government. It parallels the objectives of the Integrated Rural Development Programme, but focuses on achieving cohesion and stability in urban communities.

The ways in which the management of water resources can support urban renewal is less obvious than for rural development, but include the following -

- Contributing to the planning and development of urban river floodplains to ensure public safety, and the safety of infrastructure, during floods.
- Contributing to the health of urban rivers as social amenities by, amongst other things, ensuring compliance with licence conditions for the discharge of waste.
- Supporting public awareness campaigns on the value of urban rivers as social amenities and assisting with clean-up campaigns.

5.6 INTERNATIONAL CO-OPERATION IN WATER MATTERS

South Africa interacts on water issues with a number of countries both within and beyond Africa. Issues addressed range from water sharing agreements in international river basins with neighbouring countries to arrangements for sharing technical information and other resources with developing and developed countries.

South Africa is also party to a number of international conventions that relate to water, such as the United Nations Conventions on Biological Diversity and Combating Desertification, the United Nations Framework Convention on Climate Change, and the Ramsar Convention on Wetlands.

5.6.1 Water sharing arrangements with neighbouring states

South Africa shares four major river systems - the Orange / Senqu, Limpopo, Inkomati and Usutu / Pongola / Maputo - with its six immediate neighbours, Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe. The total area covered by the four catchments in South Africa is equal to about 60 per cent of the country's surface area, and the mean annual flow in the rivers amounts to about 40 per cent of the total average river flow in the country. Harmonious relationships with the countries with whom international rivers are shared are therefore of considerable importance and require significant technical and political interaction. A

number of bilateral and multi-lateral commissions and committees, listed below, have been established between South Africa and its neighbours. Although the bodies have a range of purposes (see Part 5 of Chapter 3) they also act as forums where co-operative arrangements for the utilisation and development of shared water resources can be discussed.

- Botswana/RSA Joint Permanent Technical Water Committee
- Lesotho Highlands Water Commission (LHWC) (Lesotho, RSA)
- Limpopo Basin Permanent Technical Committee (LBPTC) (Botswana, Mozambique, RSA, Zimbabwe)
- Mozambique/RSA Joint Water Commission
- Orange/Senqu River Basin Commission (Botswana, Lesotho, Namibia, RSA)
- Permanent Water Commission (PWC) (Namibia, RSA)
- Swaziland/RSA Joint Water Commission
- Swaziland/Mozambique/RSA Tripartite Permanent Technical Committee (TPTC)

The Orange/Senqu River Basin Commission was established in 2000 with the objective of developing an integrated water resources management plan for the river basin. The agreement to establish the Limpopo Watercourse Commission was signed in November 2003. The Incomaputo Agreement, which governs the use of shared waters in the Komati and Pongola river catchments, was signed in 2002. The agreement will be administered by the Swaziland/Mozambique/RSA TPTC until a river basin commission is established. It is anticipated that commissions^[3] will be established for the other two shared river basins during the next eight to ten years. An indicative programme for activities relating to the establishment of the commissions and their work is presented in Part 8 of Chapter 3.

All technical agreements on water sharing become effective only when they are ratified by each State, with a view to establishing a formal international agreement.

The Act is one of the few national water laws in the world that makes specific provisions for water allocations for meeting the needs of neighbouring countries with which watercourses are shared (see section 6, Appendix B). The quantitative provisions for meeting international water sharing obligations in respect of each shared watercourse are discussed in Chapter 2 and Appendix D.

5.6.2 Co-operation in the Southern African Region

Co-operation on water matters in southern Africa takes place within the framework of the Revised Protocol on Shared Watercourses in the Southern African Development Community (the SADC Protocol)^[4]. Amongst other things, the SADC Protocol addresses co-operation in respect of the harmonisation of national water policies and legislation, collecting and sharing data and information, conducting surveys and studies, developing physical infrastructure, mitigation of the effects of floods and droughts and, in general, the management of water resources for the mutual and equitable benefit of States that share watercourses. The SADC Protocol also provides for the creation of river basin management institutions to undertake these functions (refer to section 5.6.1 above).

Activities relating to the implementation of the SADC Protocol are co-ordinated by the recently created Division for Water in the Directorate for Infrastructure and Services in the SADC Secretariat in Gaborone, Botswana^[5]. The Division for Water is in the process of initiating a number of projects under the Regional Strategic Action Plan for managing and developing the water resources of the region which, when they are implemented, will give substance to the SADC Protocol's provisions.

5.6.3 Other international relationships and interactions

South Africa also interacts with a number of African countries outside the SADC region, and with countries elsewhere in the world, to develop partnerships in water management matters that could be of mutual benefit.

The objectives of these interactions include the promotion and advancement of the New Partnership for Africa's Development (NEPAD); the sharing of information, technology and expertise; the creation of opportunities for South African enterprises to work internationally; and ensuring that African interests are reflected on the agendas of global water organisations and forums.

In this respect, a number of water resources practitioners from other countries have worked with the Department in terms of training and technical assistance agreements, and reciprocal exchanges of information, especially with regard to water legislation, take place with countries and Africa and elsewhere in the world. In some cases discussions on water matters take place under the umbrellas of bi-national commissions.

5.6.4 International donor co-operation

In recent years the Department has enjoyed considerable overseas development assistance, both of a financial nature and in-kind, from a number of bilateral and multilateral agencies for water resources management, water services and forestry initiatives and projects.

The Department will continue to seek assistance from other countries to achieve its goals of equity and sustainability in water management. Future donor support is expected to focus particularly on support for projects of a regional significance. The Department will continue to collaborate actively with appropriate agencies to promote the objectives of NEPAD.

Notes to Chapter 5

- ¹ Constitutionally, the legislative responsibility for water resources management lies with the national government. There are, however, many water-dependent and water-impacting activities for which the national government and provincial and/or local governments share legislative competence. The latter competencies are described in Schedules 4 and 5 of the Constitution.
- ² Regulations on Compulsory National Standards and Measures to Conserve Water in terms of sections 9(1) and 73(1)(j) of the Water Services Act (Government Notice R509, 8th June 2001) relate to: Basic sanitation; Basic water supply; Interruption in provision of water services; Quality of potable water; Control of objectionable substances; Disposal of grey water; Use of effluent; Quantity and quality of industrial effluent discharged into a sewerage system; Water services audit as a component in the Water Services Development Plan; Water and effluent balance analysis and determination of water losses; Repair of leaks; Measurement or control of water supplied; Consumer installations other than meters; Pressure in reticulation system; Reporting of non-compliance.
- ³ The Inkomati and Usutu / Pongola / Maputo systems are adjacent to one another and are both shared by Mozambique, South Africa and Swaziland. The establishment of a joint basin commission for the two systems may be considered.
- ⁴ The Revised SADC Protocol on Shared Watercourses, revised to align it with the United Nations Convention on the Law of the Non-navigational Uses of International Watercourses, has been ratified by the required two thirds of member states, including South Africa, and came into force in September 2003. South Africa has also signed and ratified the UN Convention, but ratification by other States is required before it comes into force.
- ⁵ The Division for Water has been created in the restructuring of SADC structures, and replaces the SADC Water Sector, which was led by Lesotho.

FUNDAMENTAL PRINCIPLES AND OBJECTIVES FOR A NEW WATER LAW FOR SOUTH AFRICA**LEGAL ASPECTS OF WATER****Principle 1**

The water law shall be subject to and consistent with the Constitution in all matters including the determination of the public interest and the rights and obligations of all parties, public and private, with regards to water. While taking cognisance of existing uses, the water law will actively promote the values enshrined in the Bill of Rights.

Principle 2

All water, wherever it occurs in the water cycle, is a resource common to all, the use of which shall be subject to national control. All water shall have a consistent status in law, irrespective of where it occurs.

Principle 3

There shall be no ownership of water but only a right (for environmental and basic human needs) or an authorisation for its use. Any authorisation to use water in terms of the water law shall not be in perpetuity.

Principle 4

The location of the water resource in relation to land shall not in itself confer preferential rights to usage. The riparian principle shall not apply.

THE WATER CYCLE**Principle 5**

In a relatively arid country such as South Africa, it is necessary to recognise the unity of the water cycle and the interdependence of its elements, where evaporation, clouds and rainfall are linked to groundwater, rivers, lakes, wetlands and the sea, and where the basic hydrological unit is the catchment.

Principle 6

The variable, uneven and unpredictable distribution of water in the water cycle should be acknowledged.

WATER RESOURCE MANAGEMENT PRIORITIES**Principle 7**

The objective of managing the quantity, quality and reliability of the Nation's water resources is to achieve optimum, long term, environmentally sustainable social and economic benefit for society from their use.

Principle 8

The water required to ensure that all people have access to sufficient water shall be reserved.

Principle 9

The quantity, quality and reliability of water required to maintain the ecological functions on which humans depend shall be reserved so that the human use of water does not individually or cumulatively compromise the long term sustainability of aquatic and associated ecosystems.

Principle 10

The water required to meet the basic human needs referred to in Principle 8 and the needs of the environment shall be identified as "The Reserve" and shall enjoy priority of use by right. The use of water for all other purposes shall be subject to authorisation.

Principle 11

International water resources, specifically shared river systems, shall be managed in a manner that optimises the benefits for all parties in a spirit of mutual co-operation. Allocations agreed for downstream countries shall be respected.

WATER RESOURCE MANAGEMENT APPROACHES**Principle 12**

The National Government is the custodian of the nation's water resources, as an indivisible national asset. Guided by its duty to promote the public trust, the National Government has ultimate responsibility for, and authority over, water resource management, the equitable allocation and usage of water and the transfer of water between catchments and international water matters.

Principle 13

As custodian of the nation's water resources, the National Government shall ensure that the development, apportionment, management and use of those resources is carried out using the criteria of public interest, sustainability, equity and efficiency of use in a manner which reflects its public trust obligations and the value of water to society while ensuring that basic domestic needs, the requirements of the environment and international obligations are met.

Principle 14

Water resources shall be developed, apportioned and managed in such a manner as to enable all user sectors to gain equitable access to the desired quantity, quality and reliability of water. Conservation and other measures to manage demand shall be actively promoted as a preferred option to achieve these objectives.

Principle 15

Water quality and quantity are interdependent and shall be managed in an integrated manner, which is consistent with broader environmental management approaches.

Principle 16

Water quality management options shall include the use of economic incentives and penalties to reduce pollution, and the possibility of irretrievable environmental degradation as a result of pollution shall be prevented.

Principle 17

Water resource development and supply activities shall be managed in a manner which is consistent with the broader national approaches to environmental management.

Principle 18

Since many land uses have a significant impact upon the water cycle, the regulation of land use shall, where appropriate, be used as an instrument to manage water resources within the broader integrated framework of land use management.

Principle 19

Any authorisation to use water shall be given in a timely fashion and in a manner which is clear, secure and predictable in respect of the assurance of availability, extent and duration of use. The purpose for which the water may be used shall not arbitrarily be restricted.

Principle 20

The conditions upon which authorisation is granted to use water shall take into consideration the investment made by the user in developing infrastructure to be able to use the water.

Principle 21

The development and management of water resources shall be carried out in a manner which limits to an acceptable minimum the danger to life and property due to natural or manmade disasters.

WATER INSTITUTIONS**Principle 22**

The institutional framework for water management shall as far as possible be simple, pragmatic and understandable. It shall be self-driven and minimise the necessity for State intervention. Administrative decisions shall be subject to appeal.

Principle 23

Responsibility for the development, apportionment and management of available water resources shall, where possible and appropriate, be delegated to a catchment or regional level in such a manner as to enable interested parties to participate.

Principle 24

Beneficiaries of the water management system shall contribute to the cost of its establishment and maintenance on an equitable basis.

WATER SERVICES**Principle 25**

The right of all citizens to have access to basic water services (the provision of potable water supply and the removal and disposal of human excreta and waste water) necessary to afford them a healthy environment on an equitable and economically and environmentally sustainable basis shall be supported.

Principle 26

Water services shall be regulated in a manner which is consistent with and supportive of the aims and approaches of the broader local government framework.

Principle 27

While the provision of water services is an activity distinct from the development and management of water resources, water services shall be provided in a manner consistent with the goals of water resource management.

Principle 28

Where water services are provided in a monopoly situation, the interests of the individual consumer and the wider public must be protected and the broad goals of public policy promoted.

National Water Act: Chapter 1 - Interpretation and Fundamental Principles**Purpose of the Act**

2. The purpose of this Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors -

- (a) meeting the basic human needs of present and future generations;
- (b) promoting equitable access to water;
- (c) redressing the results of past racial and gender discrimination;
- (d) promoting the efficient, sustainable and beneficial use of water in the public interest;
- (e) facilitating social and economic development;
- (f) providing for growing demand for water use;
- (g) protecting aquatic and associated ecosystems and their biological diversity;
- (h) reducing and preventing pollution and degradation of water resources;
- (i) meeting international obligations;
- (j) promoting dam safety;
- (k) managing floods and droughts,

and for achieving this purpose, to establish suitable institutions and to ensure that they have appropriate community, racial and gender representation.

Public trusteeship of nation's water resources

3. (1) As the public trustee of the nation's water resources the National Government, acting through the Minister, must ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate.

(2) Without limiting subsection (1), the Minister is ultimately responsible to ensure that water is allocated equitably and used beneficially in the public interest, while promoting environmental values.

(3) The National Government, acting through the Minister, has the power to regulate the use, flow and control of all water in the Republic.

National Water Act: Chapter 2 - Water Management Strategies; Part 1 - National Water Resource Strategy**Establishment of national water resource strategy**

5. (1) Subject to subsection (4), the Minister must, as soon as reasonably practicable, by notice in the *Gazette*, establish a national water resource strategy.

(2) The notice must state the address where the strategy may be inspected.

(3) The water resources of the Republic must be protected, used, developed, conserved, managed and controlled in accordance with the national water resource strategy.

(4) A national water resource strategy -

(a) may be established in a phased and progressive manner and in separate components over time; and

(b) must be reviewed at intervals of not more than five years.

(5) Before establishing a national water resource strategy or any component of that strategy in terms of subsection (1), the Minister must -

(a) publish a notice in the *Gazette* -

(i) setting out a summary of the proposed strategy or the component in question;

(ii) stating the address where the proposed strategy or the component in question is available for inspection; and

(iii) inviting written comments to be submitted on the proposed strategy or the component in question, specifying an address to which and a date before which comments must be submitted, which date may not be earlier than 90 days after publication of the notice;

(b) consider what further steps, if any, are appropriate to bring the contents of the notice to the attention of interested persons, and take those steps which the Minister considers to be appropriate; and

(c) consider all comments received on or before the date specified in paragraph (a)(iii).

Contents of national water resource strategy

6. (1) The national water resource strategy must, subject to section 5(4)(a) -

(a) set out the strategies, objectives, plans, guidelines and procedures of the Minister and institutional arrangements relating to the protection, use, development, conservation, management and control of water resources within the framework of existing relevant government policy in order to achieve -

(i) the purpose of this Act; and

(ii) any compulsory national standards prescribed under section 9(1) of the Water Services Act, 1997 (Act No. 108 of 1997);

(b) provide for at least -

(i) the requirements of the Reserve and identify, where appropriate, water resources from which particular requirements must be met;

(ii) international rights and obligations;

(iii) actions to be taken to meet projected future water needs; and

(iv) water use of strategic importance;

(c) establish water management areas and determine their boundaries;

(d) contain estimates of present and future water requirements;

(e) state the total quantity of water available within each water management area;

(f) state water management area surpluses or deficits;

(g) provide for inter-catchment water transfers between surplus water management areas and deficit water management areas;

(h) set out principles relating to water conservation and water demand management;

(i) state the objectives in respect of water quality to be achieved through the classification system for water resources provided for in this Act;

(j) contain objectives for the establishment of institutions to undertake water resource management;

(k) determine the inter-relationship between institutions involved in water resource management; and

(l) promote the management of catchments within a water management area in a holistic and integrated manner.

(2) In determining a water management area in terms of subsection (1)(c), the Minister must take into account -

(a) watercourse catchment boundaries;

(b) social and economic development patterns;

(c) efficiency considerations; and

(d) communal interests within the area in question.

Giving effect to national water resource strategy

7. The Minister, the Director-General, an organ of state and a water management institution must give effect to the national water resource strategy when exercising any power or performing any duty in terms of this Act.

ADDITIONAL INFORMATION AND STRATEGIC PERSPECTIVES WITH RESPECT TO WATER MANAGEMENT AREAS

The rationale behind Appendix D

Chapter 2 of the National Water Resource Strategy (NWRS) provides an overview of the water resources situation in South Africa, supported by information for each water management area as a whole. Pronounced differences are evident among the water management areas with respect to water availability and water requirements, which are attributable to the large spatial variations in climate, the level and nature of economic development and population characteristics. Similarly, there are large differences within water management areas with respect to hydro-meteorological conditions and economic activity which cannot be adequately represented or managed without further spatial differentiation.

Water management areas were therefore divided into sub-areas to enable improved representation of the water resources situation in the country and to facilitate the applicability and better use of information for strategic management purposes. Delineation of the sub-areas was based on practical considerations such as the size and location of sub-catchments, the homogeneity of natural characteristics, the location of pertinent water infrastructure such as dams, and economic development. It is foreseen that the catchment management agencies may later introduce smaller or alternative subdivisions.

An understanding of the information contained in this Appendix will be facilitated by the background information given in Chapter 2. It is therefore recommended that Chapter 2 is studied before the more detailed information on the individual water management areas given below is referred to.

The relationship between the National Water Resource Strategy and catchment management strategies

The purpose of the NWRS is to direct the management of water strategically from a national perspective. With the water management areas serving as the primary geographic elements for water resources management, the NWRS also directs the management of inter-water management area interdependencies in the national interest, in particular with respect to the provisions for the Reserve, water quality management and transfers of water between management areas. The directives of the NWRS are prescriptive in terms of the National Water Act, 1998 (Act No. 36 of 1998) and provide the overall framework within which catchment management strategies are to be developed by the catchment management agencies. Catchment management strategies must support the broad national vision portrayed by the NWRS and may not be in conflict with it, but they will be orientated towards practical implementation at catchment level. Catchment management agencies will, however, only become fully functional after several years. To make allowance for this, the Department of Water Affairs and Forestry (the Department) has, as an interim measure in the preparation of the NWRS, developed broad strategic perspectives for each water management area. These strategic perspectives are presented in separate water management area reports and will be used by the Department for the management of water resources at water management area level until they can be refined by the Department in the short to medium term and by the catchment management agencies when they are fully operational.

Only the essence of the broad strategic perspectives, which relate mainly to issues at a national level, are contained in this Appendix. Allowances for inter-water management area transfers and other reservations as stipulated here are mandatory in terms of the NWRS. More detailed strategic action plans, following from the options presented in the NWRS, will be described in the water management area reports. The data given in this Appendix constitutes a breakdown by sub-area of the data given in Chapter 2.

Yield and available water

Fresh water results from precipitation in the form of rain, fog, hail and snow. Water that can potentially be abstracted for use runs off the land surface to appear in streams and lakes, as well as infiltrating to become groundwater. In natural equilibrium, that is, before interference by humankind, the water that is seen on the land surface is the integrated result of surface and groundwater. The total quantity of surface flow which is the average annual runoff originating from a certain geographic area is referred to as the mean annual runoff (MAR).

Water that can reliably be withdrawn from a water source at a relatively constant rate is referred to as the yield. Owing to the erratic and unreliable nature of river flow in South Africa, only a small portion of the MAR is available as yield in its natural unregulated state. By storing water during periods of high flow for

abstraction when natural stream flows are lower, the yield is increased. This is explained in more detail in Chapter 2, Box 2.1.

As indicated above, surface water and groundwater form part of the same hydrologic continuum - the hydrological cycle - and merely represent different manifestations of water in its natural state. Abstraction of groundwater therefore generally does not represent an additional source to surface water. However, groundwater does offer an alternative means of accessing the water resource and has the advantage of wide geographic availability and, typically, a smaller temporal variation than surface water. The combined use of surface and groundwater increases the proportion of water available as practical usable yield.

For the purposes of the NWRS, available water is defined as the total quantity of water that can be available for practical application to desired uses. It includes the yield from surface water and groundwater, as well as return flows from the non-consumptive use of water and water transferred from one catchment to another. The quantity of available water further depends on the location of use and the assurance of supply at which it is required, while the quality of water in relation to the quality requirements for particular uses has a direct bearing on the usability of the water. In the NWRS all yields and requirements have been standardised at a 98 per cent assurance of supply, that is, a risk of some level of failure during two out of 100 years on average. Actual water allocations must, however, take into account the required assurance of supply for specific uses.

In contrast to domestic and economic uses of water, where relatively constant availability is required, unregulated flows are preferred for ecological purposes, as these display the natural variability to which ecosystems have adapted. Water to meet ecological requirements is required to remain within the water body and is therefore not regarded as water that is available for other uses. In highly regulated systems the unregulated portion of streamflow that remains after other uses have been satisfied may not be sufficient to meet the requirements for the ecological component of the Reserve. These flows will then have to be augmented from the yield, which will result in a corresponding reduction of the water available for other purposes.

Standardised data base

To ensure compatibility of statistics among water management areas, standard national data bases were used, and standard approaches with regard to aspects such as mean annual runoff, ecological water requirements, water use by afforestation and alien vegetation, and the estimation of irrigation return flows. More accurate information in respect of specific catchments or selected areas may be available from other sources. This should not be viewed as being in conflict with the NWRS, but rather as being representative of a higher level of accuracy to be taken into account in more detailed work that may follow.

Since the information on water availability and water requirements presented in the tables in Chapter 2 this Appendix was derived small changes have been made to the boundaries of some of the water management areas (see Part 5 of Chapter 5 and Appendix E). These changes have insignificant impact on the statistics presented, and any discrepancies will be corrected at the first revision of the NWRS.

Interventions for the reconciliation of requirements and the availability of water

The main options that are available to achieve a balance between the availability of and the requirement for water are described in Section 2.5. The options include water demand management, which in most cases should receive priority, improved resource management and conservation, the increased use of groundwater, the re-use of water; the management of invasive alien vegetation, the re-allocation of water, the development of surface water resources and the inter-catchment transfer of water. Only those interventions that have particular relevance or importance with respect to a specific water management area are highlighted in the subsections that follow.

D1 WATER MANAGEMENT AREA 1: LIMPOPO

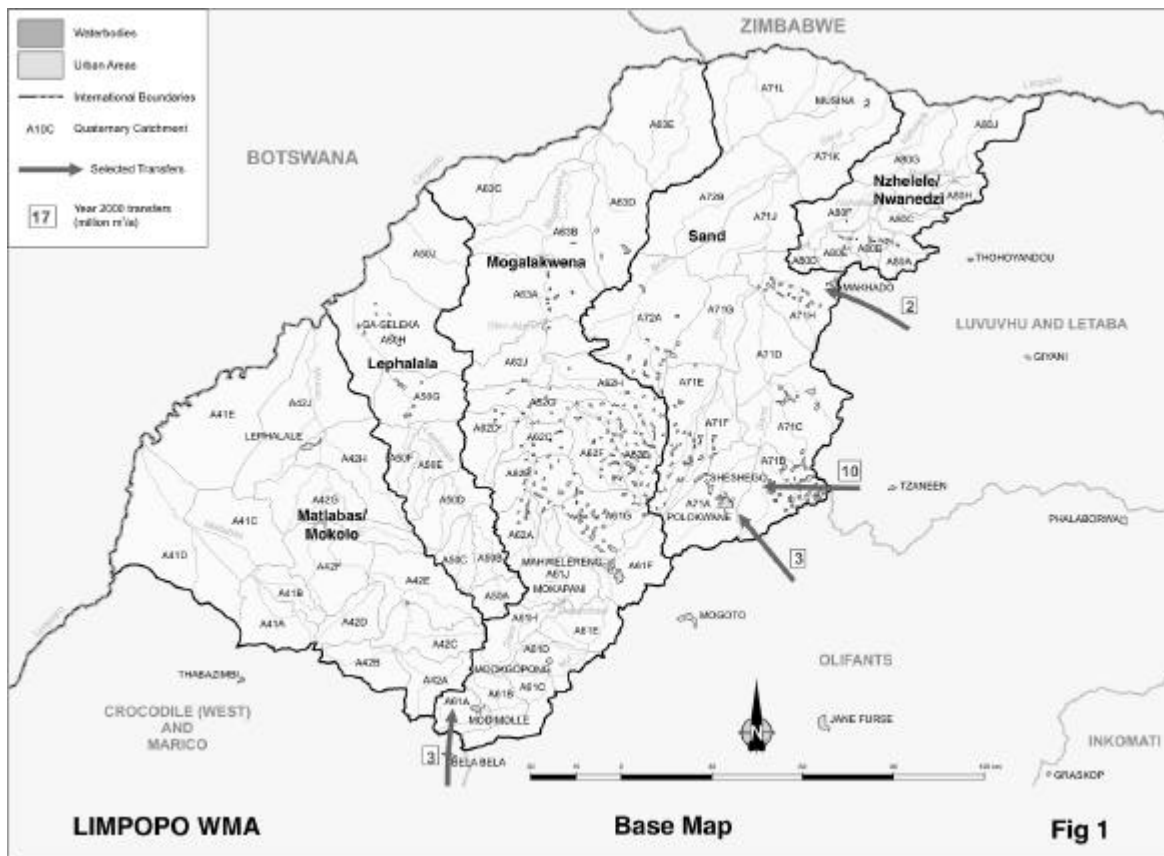
D1.1 Introduction

The Limpopo water management area (see Fig. D1) is the northern-most water management area in the country and represents part of the South African portion of the Limpopo Basin, which is also shared by Botswana, Zimbabwe and Mozambique. The water management area borders on Botswana and Zimbabwe, where the Limpopo River demarcates the entire length of the international boundaries before flowing into Mozambique. The region is semi-arid and the mean annual rainfall ranges from 300 mm to 700 mm over most of the WMA. Economic activity is mainly centred on game, livestock and irrigation farming, while mining activity is increasing. Approximately 200 rural villages are scattered throughout the area, with little local economic activity to support these population concentrations.

Due to the aridity and flatness of the terrain few sites are available for the construction of major dams and the surface water potential has largely been fully developed. Relatively favourable formations for groundwater are found in the area and groundwater is therefore used extensively. However, overexploitation occurs in localised areas. Several inter-water management area water transfers exist, as shown on Fig. D1, all of which bring water into the Limpopo water management area.

Demographic scenarios indicate a small growth in population until 2005 and little change thereafter. Significant growth in water requirements is expected from mining developments in the mineral-rich Bushveld Igneous Complex, which extends across the south-eastern part of the area, while the further exploitation of coal reserves near Ellisras could also increase water requirements. Further growth in economic activity is likely at established urban centres.

Fig. D1: Base map of the Limpopo water management area and its sub-areas



D1.2 Key statistics relevant to the Limpopo water management area

Tables D1.1 to D1.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Limpopo water management area. Data is provided for the South African land area

only and is derived primarily from the standardised data base. Different information may be available from other sources.

Table D1.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Matlabas/Mokolo	382	76
Lephalala	150	17
Mogalakwena	269	41
Sand	72	10
Nzhelele/Nwanedzi	113	12
Total for WMA³	986	156

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.
- 3) Total for RSA tributaries to the Limpopo only, excluding the main stream.

Table D1.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground- water	Irrigation	Urban	Mining and bulk industrial	
Matlabas/Mokolo	35	7	3	1	0	46
Lephalala	38	4	0	0	0	42
Mogalakwena	50	15	3	4	0	72
Sand	10	71	0	10	0	91
Nzhelele/Nwanedzi	27	1	2	0	0	30
Total for WMA	160	98	8	15	0	281

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D1.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affore- station ⁴	Total local require- ments
Matlabas/Mokolo	48	2	2	4	7	0	63
Lephalala	39	0	3	0	0	0	42
Mogalakwena	56	8	9	6	0	0	79
Sand	69	24	9	4	0	0	106
Nzhelele/Nwanedzi	26	0	5	0	0	1	32
Total for WMA	238	34	28	14	7	1	322

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D1.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Matlabas/Mokolo	46	0	63	0	(17)
Lephalala	42	0	42	0	0
Mogalakwena	72	3	79	0	(4)
Sand	91	15	106	0	0
Nzhelele/Nwanedzi	30	0	32	0	(2)
Total for WMA	281	18	322	0	(23)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D 1.5 and D 1.6.

Table D1.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Matlabas/Mokolo	45	0	62	0	(17)	0
Lephalala	42	0	43	0	(1)	0
Mogalakwena	73	3	101	0	(25)	7
Sand	92	15	107	0	0	0
Nzhelele/Nwanedzi	29	0	33	0	(4)	1
Total for WMA	281	18	346	0	(47)	8

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation. A provisional allowance of 20 million m³/a has been made for mining in the Mogalakwena catchment.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on raising the Glen Alpine and Mutshedzi Dams and construction of the Groenvley Dam.

Table D1.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component / Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Matlabas/Mokolo	46	0	64	0	(18)	0
Lephalala	42	0	43	0	(1)	0
Mogalakwena	76	3	108	0	(29)	7
Sand	102	20	130	0	(8)	0
Nzhelele/Nwanedzi	29	0	33	0	(4)	1
Total for WMA	295	23	378	0	(60)	8

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and a high impact of economic development. Assumes no general increase in irrigation. A provisional allowance of 20 million m³/a has been made for mining in the Mogalakwena catchment.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on raising the Glen Alpine and Mutshedzi Dams and construction of the Groenvley Dam.

D1.3 Key elements of the broad strategic perspectives for the Limpopo water management area

Water resources in the Limpopo water management area, although on the verge of stress, are broadly in balance with the area's water requirements. The deficits shown in Table D1.4 are attributable to the provision made for the ecological component of the Reserve. Of the total mean annual runoff of 986 million m³/a, an estimated 717 million m³/a on average still reaches the Limpopo River.

With only limited undeveloped resource potential remaining, the primary focus in the water management area should be directed towards more efficient, beneficial and equitable use of the water resources currently available. Some further development of groundwater may be possible, particularly in rural areas to supply basic human needs and for community gardens, but this should be preceded by appropriate investigations of the exploitable potential and be supported by improved management of the resource. New surface resource developments and inter-catchment transfers of water would most likely only be

affordable for high value uses. Water to supply current deficits (including the ecological Reserve), as well as for rural development, poverty relief and to redress inequities, will therefore mostly have to be obtained from existing users.

Development of the rich, but largely unexploited mineral deposits of the Bushveld Igneous Complex holds the greatest potential for economic growth in the water management area. Although the timing and extent of development are still uncertain, it is prudent that water be reserved for this purpose. A provisional allowance of 20 million m³/a, an estimate based on current mining use in other areas, has therefore been included under the Mogalakwena sub-area for future mining development in this as well as in the Sand sub-area (refer to Tables D1.5 and D1.6.)

To ensure sufficient future availability of water for mining development and urban/industrial growth, while taking into account the options described in Section 2.5, the following water quantities must be held in reserve for transfer from other water management areas to the Limpopo water management area:

- Water from the Olifants River (Olifantspoort Weir) for transfer to Polokwane, up to the full capacity of the existing pipeline of 5,0 million m³/a – reserved in the Olifants water management area.
- The existing transfer of 18,5 million m³/a maximum capacity to Polokwane from the Ebenezer and Dap Naude Dams in the Luvuvhu and Letaba water management area – reserved in the Luvuvhu and Letaba water management area.
- The existing transfer of 2,4 million m³/a from Albasini Dam in the Luvuvhu and Letaba water management area to Makhado, supplemented by an additional 5 million m³/a from the Luvuvhu River – reserved in the Luvuvhu and Letaba water management area.
- About 45 million m³/a (assumed at half of Sasol II's requirements) of the growth in effluent return flows to the Crocodile River may be required for the development of coal reserves in the Lephallale area. Since considerable uncertainty still surrounds this possibility, this requirement is not included in Tables D1.5 and D1.6, or in Tables D3.5 and D3.6 – reserved in the Crocodile (West) and Marico water management area.
- Water from the development of the Rooipoort Dam on the Olifants River mainly to supply possible new mining-related developments in the Olifants water management area and the Mogoto to Mokopane area as well as for Polokwane. Other developments that could have a negative on the Rooipoort development will not be allowed – reserved in the Olifants water management area.
- The development of new dams or large water resource projects will be subject to national authorisation because of their possible impact on neighbouring countries - reservation with respect to the Limpopo water management area.
- Small transfer from the Crocodile (West) and Marico water management area to Modimolle in the Limpopo water management area – reserved in the Crocodile (West) and Marico water management area.

D2 WATER MANAGEMENT AREA 2: LUVUVHU AND LETABA

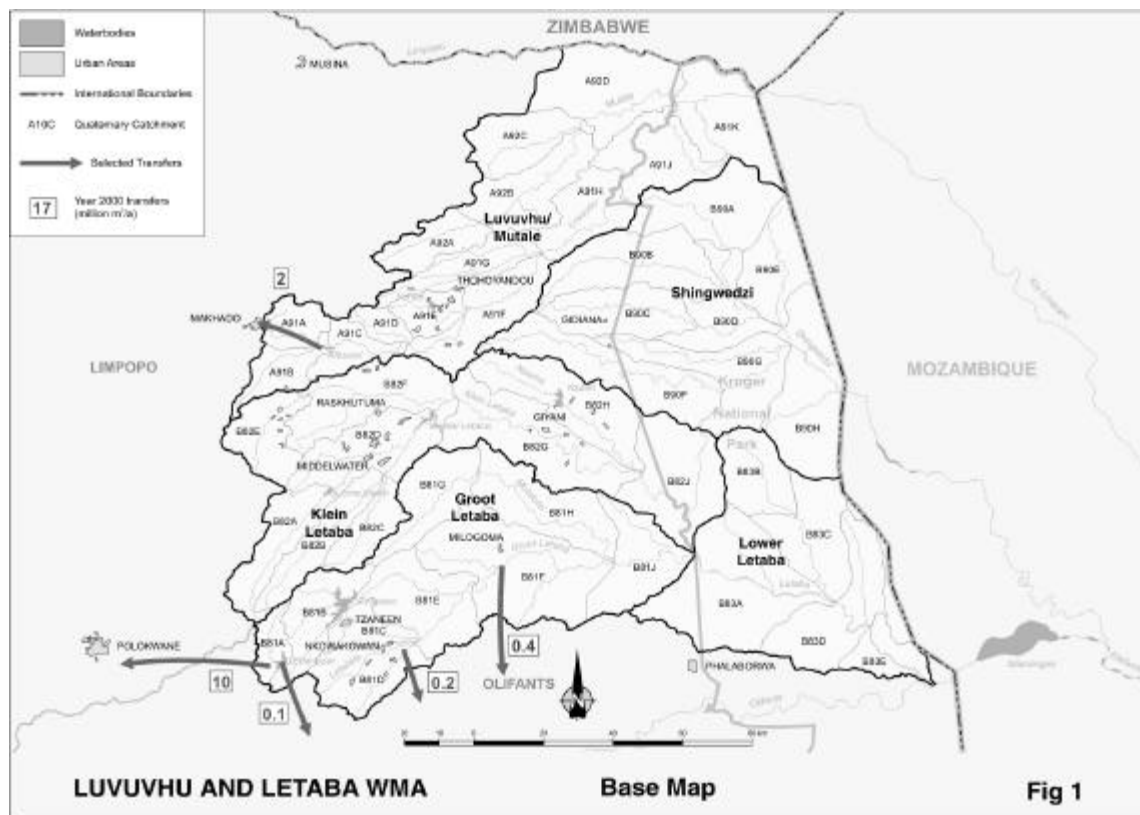
D2.1 Introduction

The Luvuvhu and Letaba water management area lies entirely within the Limpopo Province and borders on Zimbabwe and Mozambique. It forms part of the Limpopo Basin, which is shared by South Africa, Botswana, Zimbabwe and Mozambique. While the Luvuvhu River is a direct tributary of the Limpopo River, the Shingwedzi and Letaba Rivers flow into the Olifants River, which is a tributary of the Limpopo. A unique feature of this water management area is the Kruger National Park along its eastern boundary, which occupies approximately 35 per cent of the area and through which all the main rivers flow into Mozambique, as shown in Fig. D2. Due to the topography, rainfall varies from well over 1 000 mm/a to less than 300 mm/a. Economic activity is characterised by irrigation, afforestation, tourism and informal farming. Over 90 per cent of the area's population of about 1.5 million live in rural communities.

Surface water mainly originates in the mountainous areas and is regulated by several dams in the upper and middle reaches of the rivers. The Nandoni Dam is under construction on the Luvuvhu River and other sites have been identified as being feasible for the construction of dams in the future. Groundwater is utilised extensively and limited potential remains for further development. Significant over-exploitation of groundwater occurs in parts of the water management area, particularly near Albasini Dam and in the vicinity of Thohoyandou. Water transfers occur from this water management area to both neighbouring water management areas and some inter-catchment transfers within the water management area also take place.

Current expectations are that population growth in the area will be moderate, probably at less than 0,8 per cent per annum. New mining developments are foreseen in the Tzaneen/Gravelotte area and coal mining could possibly commence near Tshikondeni. A water allocation has been reserved from Nandoni Dam for the irrigation of 1 100 ha of farmland to be set aside for the purposes of rural development and poverty relief. It is doubtful whether any further expansion of irrigation will be economically viable. No dramatic growth in future water requirements is therefore expected, with the possible exception of developments related to mining.

Fig. D2: Base map of the Luvuvhu and Letaba water management area



D2.2 Key statistics relevant to the Luvuvhu and Letaba water management area

Tables D2.1 to D2.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Luvuvhu and Letaba water management area. The data is primarily derived from the standardised database and different information may be available from other sources.

Table D2.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Luvuvhu/Mutale	520	105
Shingwedzi	90	14
Groot Letaba	382	72
Klein Letaba	151	20
Lower Letaba	42	13
Total for WMA	1 185	224

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with the impact on yield being a portion of this.

Table D2.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground- water	Irrigation	Urban	Mining and bulk	
Luvuvhu/Mutale	88	20	5	2	0	115
Shingwedzi	1	2	0	0	0	3
Groot Letaba	133	12	13	1	0	159
Klein Letaba	21	9	1	1	0	32
Lower Letaba	1	0	0	0	0	1
Total for WMA	244	43	19	4	0	310

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D2.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local requirements
Luvuvhu/Mutale	97	4	10	1	0	7	119
Shingwedzi	0	0	3	0	0	0	3
Groot Letaba	126	3	10	0	0	35	174
Klein Letaba	25	3	8	0	0	1	37
Lower Letaba	0	0	0	0	0	0	0
Total for WMA	248	10	31	1	0	43	333

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D2.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers In ²	Local requirements	Transfers out ²	Balance ¹
Luvuvhu/Mutale	115	0	119	2	(6)
Shingwedzi	3	0	3	0	0
Groot Letaba	159	0	174	11	(26)
Klein Letaba	32	0	37	0	(5)
Lower Letaba	1	0	0	0	1
Total for WMA	310	0	333	13	(36)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D2.5 and D2.6.

Table D2.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance (3)	Potential for develop- ment ⁴
Luvuvhu/Mutale	208	0	129	2	77	60
Shingwedzi	3	0	3	0	0	0
Groot Letaba	160	0	177	11	(28)	42
Klein Letaba	32	0	39	0	(7)	0
Lower Letaba	1	0	0	0	1	0
Total for WMA	404	0	348	13	43	102

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000 (Nandoni Dam). Also includes return flows resulting from a growth in requirements.
- 2) Based on growth in water requirements as a result of population growth and general economic development. Irrigation of an additional 1100 ha from the Nandoni Dam has been allowed for in the Luvuvhu/Mutale sub-area. .
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on raising the Tzaneen Dam, construction of the Nwamitwa Dam and the possible construction of a dam on the Mutale River.

Table D2.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Luvuvhu/Mutale	208	0	129	2	77	60
Shingwedzi	3	0	3	0	0	0
Groot Letaba	161	0	179	11	(29)	42
Klein Letaba	33	0	39	0	(6)	0
Lower Letaba	1	0	0	0	1	0
Total for WMA	406	0	350	13	43	102

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000 (Nandoni Dam). Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Irrigation of an additional 1100 ha from the Nandoni Dam has been allowed for in the Luvuvhu/Mutale sub-area.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on raising the Tzaneen Dam, construction of the Nwamitwa Dam and the possible construction of a dam on the Mutale River.

D2.3 Key elements of the broad strategic perspectives for the Luvuvhu and Letaba water management area

From Table D2.4 it is evident that there is no surplus yield available in the water management area and that an over-commitment of resources is shown to occur. This is mainly attributable to the provision made for the future implementation of the ecological component of the Reserve. The deficits in parts of the water management area will be relieved once the Nandoni Dam is commissioned. A surplus will then exist downstream of the dam, part of which is intended for use by emerging farmers. Of the mean annual runoff

of 1 185 million m³/a originating in the water management area, an estimated 790 million m³/a on average still flows into Mozambique.

With due consideration for the options described in Section 2.5, the general perspective is that current shortfalls and the future growth in requirements will be supplied from water freed up as a result of water demand management and the re-allocation of irrigation water. Some further development of groundwater may be possible, but this should be preceded by appropriate investigations of the exploitable potential and be supported by improved management of the resource. Options also exist for the raising of Tzaneen Dam and construction of the proposed nWamitwa Dam. However, the construction of new dams will probably only be affordable for high-value uses, such as mining and related developments, and under certain conditions for irrigation. Water for poverty relief and rural development should be re-allocated from existing irrigation.

Implementation of the Reserve is of special importance with respect to the Kruger National Park and priority should be given to implementation planning. Provision for the Reserve should preferably be incorporated into the planning of possible future developments, thereby minimising the socio-economic impact.

The following reservations with respect to developments and water resources will apply to the Luvuvhu and Letaba water management area:

- Development of all new dams or large water resource projects will be subject to national authorisation because of possible impacts on Mozambique.
- Water reserved in the Luvuvhu and Letaba water management area for transfer to users in neighbouring water management areas:
 - The existing transfer of 2.4 million m³/a from the Albasini Dam to Makhado in the Limpopo water management area.
 - An additional 5 million m³/a to be reserved from either the Albasini or the Nandoni Dam for possible transfer to Makhado in the Limpopo water management area.
 - A maximum of 18.5 million m³/a per year to be available from the Ebenezer and Dap Naude Dams for transfer to Polokwane in the Limpopo water management area. (Existing)
 - Existing transfers of approximately 0.7 million m³/a from the Groot Letaba River to Gravelotte and other users in the Olifants water management area.

D3 WATER MANAGEMENT AREA 3: CROCODILE (WEST) AND MARICO

D3.1 Introduction

The Crocodile (West) and Marico water management area borders on Botswana to the north-west. Its main rivers, the Crocodile and Marico, give rise to the Limpopo River at their confluence. The climate is generally semi-arid, with the mean annual rainfall ranging from 400 mm to 800 mm. Extensive irrigation development occurs along the main rivers, with grain, livestock and game farming in other parts. A general orientation is given by Fig. D3.

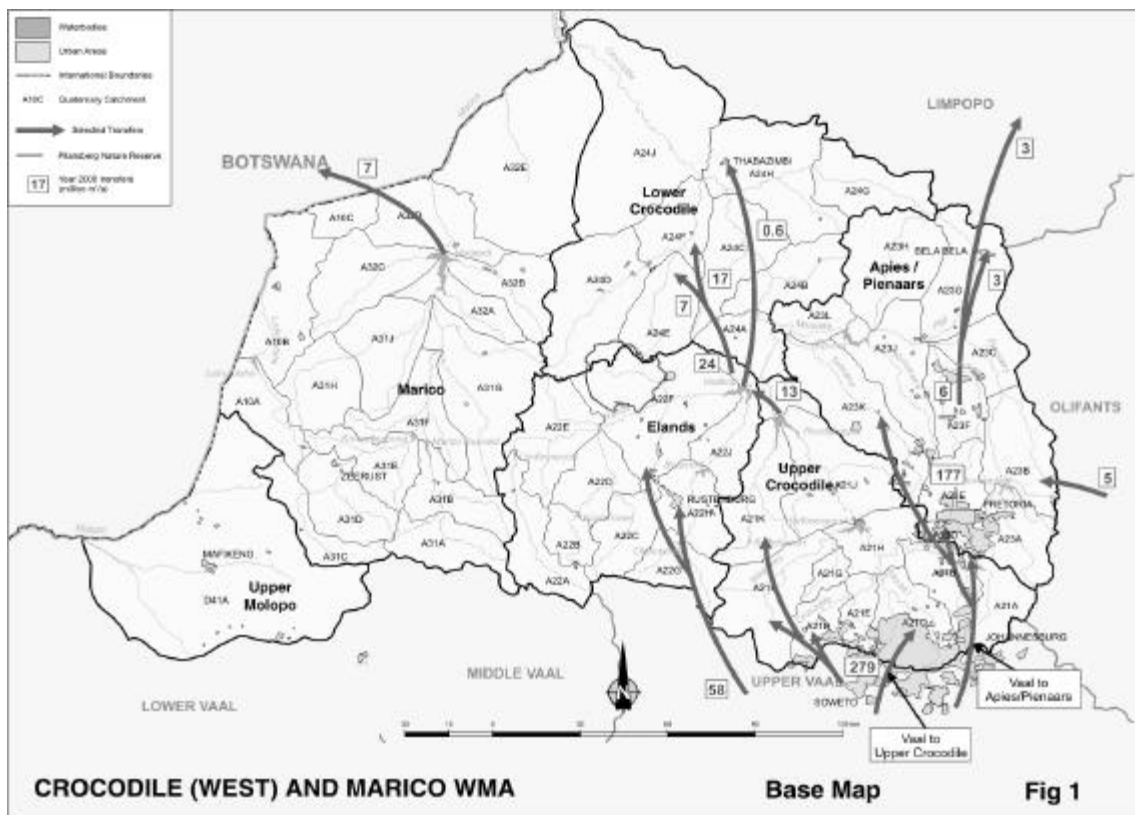
Economic activity in the water management area is dominated by the urban and industrial complexes of northern Johannesburg and Pretoria and platinum mining north-east of Rustenburg. It is the second most populous water management area in the country and has the largest proportionate contribution to the national economy.

Development and utilisation of surface water occurring naturally in the water management area has reached its full potential. Large dolomitic groundwater aquifers occur along the southern part of the area, which is the reason for part of the Upper Molopo River catchment being incorporated into the area. The aquifers are utilised extensively for urban and irrigation purposes. Localised over-exploitation of groundwater occurs in the Molopo area. Some aquifers also underlie the border with Botswana and are shared with that country. A substantial portion of the water used in the water management area is transferred from the Vaal River and further afield. Small transfers out of the water management area are to Gabarone in Botswana and to Modimolle in the Limpopo water management area.

Increasing quantities of effluent return flow from urban and industrial areas offer considerable potential for re-use, but the effluent is at the same time a major cause of pollution in some rivers.

Population and economic growth, centred on the Johannesburg-Pretoria metropolitan complex and mining developments, are expected to continue strongly in this area. Little change is foreseen in population and economic development in rural areas.

Fig. D3: Base map of the Crocodile (West) and Marico water management area



D3.2 Key statistics relevant to the Crocodile (West) and Marico water management area

Tables D 3.1 to 3.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Crocodile (West) and Marico water management area. The data is primarily derived from the standardised data base. Different information may be available from other sources.

Table D3.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Apies/Pienaars	142	34
Upper Crocodile	253	57
Elands	113	15
Lower Crocodile	138	25
Marico	172	29
Upper Molopo	37	4
Total for WMA	855	164

- 1) Quantities are incremental and refer only to the sub-area under consideration.
- 2) The total volume is based on preliminary estimates, with the impact on yield being a portion of this.

Table D3.2: Available water in year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground- water	Irrigation	Urban	Mining and bulk	
Apies/Pienaars	38	36	4	106	2	186
Upper Crocodile	111	31	21	158	15	336
Elands	30	29	3	10	14	86
Lower Crocodile	7	29	14	1	8	59
Marico	14	12	2	3	1	32
Upper Molopo	3	9	0	5	2	19
Total for WMA	203	146	44	283	42	718

- 1) After allowance for the impacts on yield of the ecological component of Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D3.3: Year 2000 water requirements (million m³/a)

Sector/ Sub-area	Irrigation	Urban¹	Rural¹	Mining and bulk industrial²	Power generation³	Affores- tation⁴	Total local require- ments
Apies/Pienaars	41	211	7	6	15	0	280
Upper Crocodile	208	292	5	38	13	0	556
Elands	32	23	10	48	0	0	113
Lower Crocodile	137	3	3	28	0	0	171
Marico	24	5	9	2	0	0	40
Upper Molopo	3	13	3	5	0	0	24
Total for WMA	445	547	37	127	28	0	1 184

- 1) Includes Reserve component for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D3.4: Reconciliation of water requirements and available water for year 2000 (million m³/a)

Component/ Sub-area	Local Yield	Transfers in²	Local requirements	Transfers out²	Balance¹
Apies/Pienaars	186	182	280	87	1
Upper Crocodile	336	279	556	17	42
Elands	86	71	113	24	20
Lower Crocodile	59	112	171	0	0
Marico	32	0	40	7	(15)
Upper Molopo	19	0	24	0	(5)
Total for WMA	718	519	1 184	10	43

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the transfers per sub-area therefore does not necessarily correspond to the total of transfers into and out of the WMA. The same applies to Tables D3.5 and D3.6.

Table D3.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Apies/Pienaars	244	287	399	92	40	0
Upper Crocodile	399	382	673	13	95	0
Elands	90	71	124	24	13	0
Lower Crocodile	59	113	173	0	(1)	0
Marico	32	0	40	7	(15)	0
Upper Molopo	22	0	29	0	(7)	0
Total for WMA	846	727	1 438	10	125	0

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements. It is assumed that water will be transferred into Apies/Pienaars and Upper Crocodile sub-areas from the Upper Vaal water management area to meet the anticipated growth in requirements.
- 2) Based on growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate negative balance.
- 4) No significant potential for the further development of local resources.

Table D3.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component / Sub-area	Local yield ¹	Transfers In	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Apies/Pienaars	360	517	630	95	152	0
Upper Crocodile	511	584	880	13	202	0
Elands	97	71	141	24	3	0
Lower Crocodile	62	116	179	0	(1)	0
Marico	33	0	42	7	(16)	0
Upper Molopo	21	0	27	0	(6)	0
Total for WMA	1 084	1 159	1 899	10	334	0

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000 and includes return flows resulting from the growth in requirements. It is assumed that water to meet the anticipated growth in water requirements will be transferred into Apies/Pienaars and Upper Crocodile sub-areas from the Upper Vaal water management area.
- 2) Based on growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) There is no significant potential for the further development of local resources.

D3.3 Key elements of the broad strategic perspectives for the (Crocodile) West and Marico water management area

The key considerations for the Crocodile (West) and Marico water management area are that its own water resources are already fully utilised, the importance of transfers and return flows in the water balance, and the continued strong growth expectations in the Pretoria-Johannesburg and the Platinum Belt regions. Inherently these factors will impact on flows and water quality along the Crocodile River and also on South Africa's international obligations. Compared to the natural mean annual runoff of 855 million

m³/a that originates in the water management area, an estimated 549 million m³/a still flows out of the area, 96 per cent to the Limpopo River.

Important considerations that will have to receive attention are the optimal use of return flows, the maintenance of an optimal balance between the urban re-use of return flows and transfers of water into the water management area, and water quality management. Water demand management, combined with the other options for the reconciliation of requirements and the availability of water, as described under Section 2.5, should receive due consideration. After that, growth in requirements in the Pretoria-Johannesburg area will mainly have to be supplied from transfers, while growth in the Elands and Lower Crocodile sub-areas can largely be supplied from increasing return flows. Much of the requirements of the ecological component of the Reserve can also be supplied from return flows, although intervention may be required to ensure the appropriate temporal distribution of flows.

The following reservations will apply with respect to the Crocodile (West) and Marico water management area:

- An additional 220 million m³/a will have to be transferred from the Upper Vaal and water management areas beyond to the Pretoria-Johannesburg area in future. As an upper high-growth scenario, up to 750 million m³/a may be required – reserved in the Upper Vaal water management area.
- Surplus effluent return flows that become available are to be reserved in the Crocodile (West) and Marico water management area for the following priorities:
 - Re-use for urban, industrial and mining purposes where this will feasibly contribute to reducing transfers into the water management area.
 - About 45 million m³/a may be required for developments in the Lephalale area in the Limpopo water management area. This quantity is not included in Tables D3.5 and D3.6.
 - Small quantities may be required to augment supplies in the Limpopo and Olifants water management areas.
- The transfer of about 7 million m³/a from the Molatedi Dam to Gabarone in Botswana – reserved in the Crocodile (West) and Marico water management area.
- Continuation of small transfers from the Olifants to the Crocodile (West) and Marico water management area, as well as from the Crocodile (West) and Marico to the Limpopo water management area – reserved in the Olifants, and Crocodile (West) and Marico water management areas respectively.
- Water resource developments that may negatively influence the flow of water towards neighbouring countries will be subject to national authorisation – reservation with respect to Crocodile (West) and Marico water management area.

D4 WATER MANAGEMENT AREA 4: OLIFANTS

D4.1 Introduction

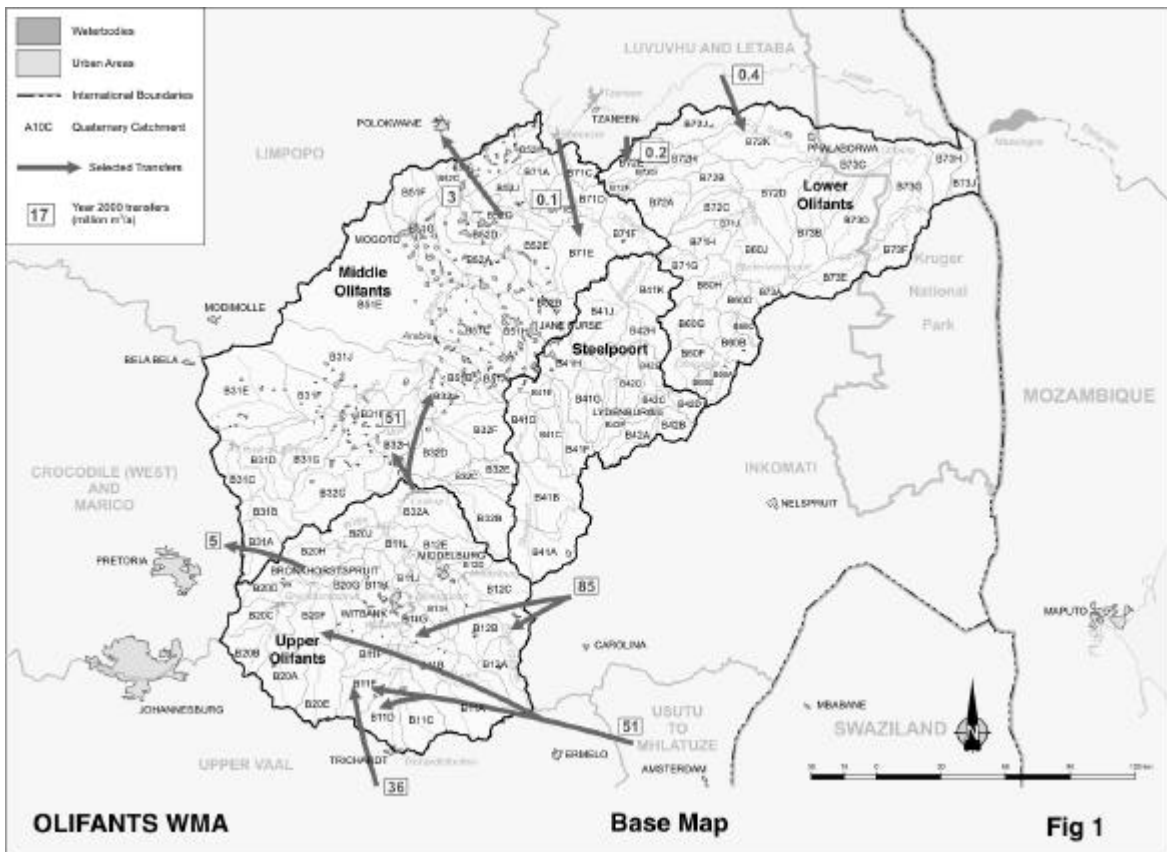
The Olifants River originates to the east of Johannesburg and initially flows northwards before gently curving eastwards towards the Kruger National Park (KNP), where it is joined by the Letaba River before flowing into Mozambique. As shown on Fig. D4, the Olifants water management area corresponds with the South African portion of the Olifants River catchment, excluding the Letaba River catchment, which is a tributary catchment to the Limpopo Basin shared by South Africa, Botswana, Zimbabwe and Mozambique. Distinct differences in climate occur; from cool Highveld in the south to subtropical east of the escarpment. Mean annual rainfall is in the range of 500 mm to 800 mm over most of the WMA.

Economic activity is highly diverse and ranges from mining and metallurgic industries to irrigation, dry land and subsistence agriculture, and eco-tourism. With one of the main rivers, the Olifants, flowing through the KNP, which is located at the downstream extremity of the water management area, the provision of water to meet ecological requirements is one of the controlling factors in the management of water resources throughout the water management area.

Most surface runoff originates from the higher rainfall southern and mountainous areas and is controlled by several large dams. The most promising options identified for the further development of surface water resources are the raising of Flag Boshielo Dam, the construction of a new dam at Rooipoort on the middle Olifants River and a dam on the Steelpoort River.

Large quantities of groundwater are abstracted for irrigation in the north-west of the water management area, as well as for rural water supplies throughout most of the area. Potential for increased groundwater utilisation has been identified on the Nebo Plateau north-east of Groblersdal. Substantial amounts of water are transferred into the water management area as cooling water for power generation, while smaller transfers are made to neighbouring water management areas.

Fig D4: Base map of the Olifants water management area



The scenarios for population growth show little if any increase in the rural areas beyond 2025. Economic growth and population increases are expected to be centred on the main industrial and mining towns of Witbank, Middelburg and Phalaborwa, as well as at new mining developments foreseen along the eastern limb of the Bushveld Igneous Complex in the Mogoto/Steelpoort area. Water requirements for power generation in the upper Olifants sub-area are also expected to increase. Water for mining developments in the Mokopane area (Limpopo water management area) may have to be supplied from the Olifants River.

D4.2 Key statistics relevant to the Olifants water management area

Tables D4.1 to D4.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Olifants water management area. Data is primarily derived from the standardised data base. Different information may be available from other sources.

Table D4.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR	Ecological Reserve ¹
Upper Olifants	465	83
Middle Olifants	481	69
Steelpoort	396	94
Lower Olifants	698	214
Total for WMA	2 040	460

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D4.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Upper Olifants	194	4	2	34	4	238
Middle Olifants	100	70	34	5	1	210
Steelpoort	42	14	3	1	1	61
Lower Olifants	74	11	5	2	8	100
Total for WMA	410	99	44	42	14	609

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D4.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local require- ments
Upper Olifants	44	62	6	20	181	1	314
Middle Olifants	336	15	28	13	0	0	392
Steelpoort	69	3	5	17	0	1	95
Lower Olifants	108	7	5	43	0	1	164
Total for WMA	557	87	44	93	181	3	965

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D4.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Upper Olifants	238	171	314	96	(1)
Middle Olifants	210	91	392	3	(94)
Steelpoort	61	0	95	0	(34)
Lower Olifants	100	1	164	0	(63)
Total for WMA	609	172	965	8	(192)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D4.5 and D4.6.

Table D4.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Upper Olifants	256	209	383	82	0	0
Middle Olifants	212	77	430	2	(143)	152
Steelpoort	62	0	96	0	(34)	87
Lower Olifants	100	1	165	0	(64)	0
Total for WMA	630	210	1 074	7	(241)	239

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development, including an additional 25 million m³/a required for mining in the Middle Olifants sub-area. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Flag Boshielo Dam and construction of the Rooipoort and De Hoop Dams.

Table D4.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out ⁵	Balance ³	Potential for develop- ment ⁴
Upper Olifants	287	209	439	57	0	0
Middle Olifants	213	52	433	8	(176)	152
Steelpoort	63	0	98	0	(35)	87
Lower Olifants	102	1	171	0	(68)	0
Total for WMA	665	210	1 141	13	(279)	239

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on growth in water requirements as a result of population growth and general economic development, including an additional 25 million m³/a required for mining in the Middle Olifants sub-area. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Flag Boshielo Dam and construction of Rooipoort and De Hoop Dams.
- 5) Not including possible future transfers to the Limpopo WMA for Polokwane and Mokopane as described below.

D4.3 Key elements of the broad strategic perspectives for the Olifants water management area

From the reconciliation in Table D4.4, deficits are apparent along the whole of the Olifants River, except for the upstream reaches. This is attributable to the provision for the ecological component of the Reserve, without which the system could generally be regarded as being in balance. Savings of approximately 20 per cent will be required to meet current shortfalls and provide for the ecological component of the Reserve. To meet these requirements, water will therefore need to be freed up by means of compulsory licensing and supporting measures such as water demand management. Judicious assessment of the Reserve together with careful implementation planning to minimise possible social disruption will be required. Of the total mean annual runoff of 2 040 million m³/a, an estimated average of 1 137 million m³/a still flows into Mozambique.

Water quality is highly impacted upon by coal mining in the Upper Olifants sub-area. Special remedial measures have been implemented to control the discharge of mine leachate and wash-off to within the assimilative capacity of the natural streams. Priority attention will continue to be needed to contain pollution from mines, also after the discontinuation of operations.

Further resource development through the construction of new infrastructure will be very expensive and is unlikely to be affordable by irrigation farming. Water for irrigation as a means of rural development and poverty relief will therefore have to be sourced largely through re-allocation from existing users. With water resources in the Upper Olifants already fully developed and utilised, a growth in power generation requirements will have to be provided for by increased transfers of water.

Water for new mining development in the Middle Olifants and Steelpoort sub-areas (reflected in the tables under the Middle Olifants) can be provided by raising the Flag Boshielo Dam, the construction of a dam on the Steelpoort River, or from the proposed Rooipoort Dam.

With due consideration of the options available for reconciling the requirements for and the availability of water, as described in Section 2.5, the following reservations will apply with respect to the Olifants water management area:

- Water from the Rooipoort Dam to be developed in the main stem of the Olifants River is to be reserved in the Olifants water management area primarily for supplying future mining developments within the water management area and for possible transfers to Polokwane and Mokopane in the Limpopo water

management area. Water resource developments elsewhere in the catchment that could have a significant negative impact on this will not be permitted.

- Similar reservation will apply with regard to a large dam to be constructed on the Steelpoort River, possibly at De Hoop, in the Olifants water management area.
- Currently, 172 million m³/a of water is transferred from the Inkomati, Usutu to Mhlatuze and Upper Vaal water management areas to the Olifants water management area for strategic use in power generation. A further 38 million m³/a is to be reserved in the Upper Vaal water management area for this purpose. The Upper Vaal water management area will in turn source this water from other water management areas. Details of the reservations are given in the descriptions of the relevant source water management areas.
- The transfer of water from the Olifantspoort Weir to Polokwane in the Limpopo water management area at the maximum pipeline capacity of 5.0 million m³/a.– reserved in the Olifants water management area.
- The existing water transfer from the Wilge tributary of the Olifants River to Cullinan and Premier Diamond Mine in the Crocodile (West) and Marico water management area – reserved in the Olifants water management area.
- The existing water transfer from the Letaba River in the Luvuvhu and Letaba water management area to users in the Olifants water management area – reserved in the Luvuvhu and Letaba water management area.
- All water resource developments that could have a possible impact on Mozambique will be subject to national authorisation – reservation applicable to Olifants water management area.

D5 WATER MANAGEMENT AREA 5: INKOMATI

D5.1 Introduction

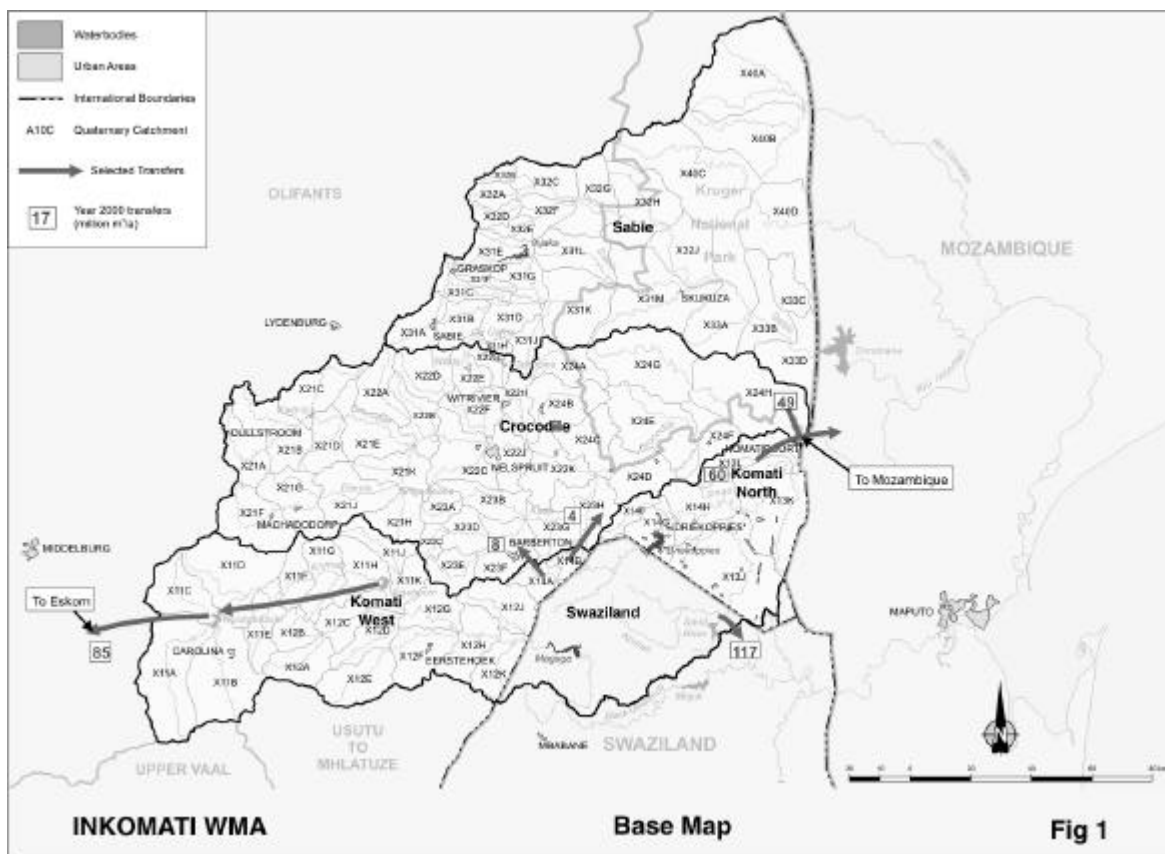
The Inkomati water management area is situated in the north-eastern part of South Africa and borders on Mozambique and Swaziland. As shown on Fig. D5, all the rivers from this area flow through Mozambique to the Indian Ocean. The Komati River flows into Swaziland and re-enters South Africa before flowing into Mozambique. Topographically the water management area is divided by the escarpment into a plateau in the west and a subtropical Lowveld in the east. Annual rainfall varies from close to 1 500 mm in the mountains to 400 mm in the lower-lying areas.

Economic activity is mainly centred on irrigation and afforestation, with related industries and commerce, and a strong eco-tourism industry. A key feature of the water management area is the renowned Kruger National Park. The Sabie River, which flows through the park, is ecologically one of the most important rivers in South Africa, while the Crocodile River forms the park's southern boundary.

Dams have been constructed on all the main rivers or their tributaries, and surface water resources in the water management area are generally well regulated. An important feature is the joint management by South Africa and Swaziland of part of the water resources of the Komati River by the Komati Basin Water Authority (KOBWA). Potential for further water resource development exists in the Kaap tributary of the Crocodile River, the Komati River and the Sand tributary of the Sabie River, although such development will probably only be feasible for domestic and high value uses. Because of the well-watered nature of most of the area, groundwater utilisation is relatively small. Most of the present yield from the Komati River west of Swaziland is transferred to the Olifants water management area for power generation.

Future population growth in the area is expected to be moderate and to be concentrated in the urbanised areas. In some rural areas the population could decline. With about 90 per cent of total water requirements within the water management area being utilised by the irrigation and forestry sectors, only a small natural growth in overall water requirements is foreseen.

Fig. D5: Base map of the Inkomati water management area



D5.2 Key statistics relevant to the Inkomati water management area

Tables D5.1 to D5.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Inkomati water management area. Although the water management area is restricted to South Africa, information is included for Swaziland to provide a more comprehensive perspective. The data is derived primarily from the standardised data base. Different information may be available from other sources.

Table D5.1: Natural mean annual runoff and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Komati (W Swazi)	749	239
Swaziland ³	517	100
Komati (N Swazi)	130	25
Crocodile	1 277	328
Sabie ⁴	866	316
Total for WMA	3 539	1 008

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, impact on yield being a portion of this.
- 3) Includes the Komati and Lomati catchments in Swaziland.
- 4) Includes the Uanetse and Mássintonto catchments in South Africa.

Table D5.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Komati (W Swazi)	116	1	0	1	0	118
Swaziland	183	1	1	0	0	185
Komati (N Swazi)	228	2	21	0	1	252
Crocodile	202	2	26	6	10	246
Sabie	87	3	5	0	0	95
Total for WMA	816	9	53	7	11	896

- 1) After allowance for the impacts on yield of the ecological component of Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff. Includes Driekoppies Dam, but not the soon-to-be completed Maguga Dam.

Table D5.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local require- ments
Komati (W Swazi)	21	2	4	0	0	38	65
Swaziland	35	1	6	0	0	25	67
Komati (N Swazi)	215	3	6	1	0	7	232
Crocodile	257	35	7	23	0	42	364
Sabie	65	22	4	0	0	26	117
Total for WMA	593	63	27	24	0	138	845

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities only refer to the impact on yield.

Table D5.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers In ²	Local requirements	Transfers out ²	Balance ¹
Komati (W Swazi)	118	0	65	97	(44)
Swaziland	185	0	67	117	1
Komati (N Swazi)	252	0	232	60	(40)
Crocodile	246	12	364	49	(155)
Sabie	95	0	117	0	(22)
Total for WMA	896	0	845	311	(260)

- 1) Brackets around numbers indicate a negative balance.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D5.5 and D5.6.

Table D5.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Komati (W Swazi)	118	0	64	97	(43)	40
Swaziland	250	0	95	156	(1)	0
Komati (N Swazi)	252	39	233	60	(2)	0
Crocodile	249	12	381	49	(169)	64
Sabie	159	0	141	0	18	0
Total for WMA	1 028	0	914	311	(197)	104

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000, including the Maguga and Inyaka Dams. Also includes return flows resulting from a growth in requirements.
- 2) Based on growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of Boekenhoutrand and Mountain View Dams.

Table D5.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Komati (W Swazi)	119	0	67	97	(45)	40
Swaziland	250	0	95	156	(1)	0
Komati (N Swazi)	252	39	233	60	(2)	0
Crocodile	256	12	423	49	(204)	64
Sabie	159	0	139	0	20	0
Total for WMA	1 036	0	957	311	(232)	104

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000, including the Maguga and Inyaka Dams. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of Boekenhoutrand and Mountain View Dams.

D5.3 Key elements of the broad strategic perspectives for the Inkomati water management area

Of primary importance for the Inkomati water management area is the implementation of the Reserve and the release of minimum flows to Mozambique. Of the total mean annual runoff of 3 539 million m³/a that originates in the water management area and the Swaziland portion of the Komati River catchment, an estimated 1 857 million m³/a on average currently flows into Mozambique.

According to an agreement between South Africa, Swaziland and Mozambique, the first two are obliged to release a minimum flow of 109 million m³/a to Mozambique at Komatipoort (55 per cent from the Komati River and 45 per cent from the Crocodile River). Water requirements in South Africa have, however, grown to the extent that the total available yield from these rivers could be absorbed by local requirements. The deficits reflected in Table D5.4 are therefore about equal to the requirements of the ecological component of the Reserve and the obligations to Mozambique. No quantitative agreements exist for the other rivers shared with Mozambique.

The bulk of water use in the water management area is for irrigation and afforestation, and the expectation is that new resource development is likely to be too costly for the expansion of these uses. It is evident that, with due consideration of the available options for reconciling the requirements for and availability of water as described under Section 2.5, compulsory licensing will have to be applied to reapportion water use in the water management area. This is to be preceded by the detailed determination and careful assessment of the requirements for the ecological component of the Reserve.

The following reservations and national authorisations apply to the Komati water management area:

- The transfer of water to the Olifants water management area for power generation at the current capacity of approximately 100 million m³/a. The treaty between South Africa and Swaziland accommodates a transfer of 132 million m³/a out of the catchment, which must be reserved in the Komati water management area.
- Water supplied to South Africa by the Komati Basin Water Authority, which includes releases for environmental purposes – reserved by international agreement for use in the Komati water management area.
- Water to be released to Mozambique to honour international commitments. This currently amounts to 109 million m³/a – reserved in the Komati water management area.
- All water resource developments that may impact on neighbouring countries will be subject to national authorisation – reservation applies to the Komati water management area.

D6 WATER MANAGEMENT AREA 6: USUTU TO MHLATUZE

D6.1 Introduction

The Usutu to Mhlhatuze water management area falls predominantly within northern KwaZulu-Natal with a part in Mpumalanga, and bordering on Swaziland and Mozambique (refer to Fig. D6). Two rivers are shared with these countries. The Usutu River has its headwaters in South Africa and flows into Swaziland, while part of the Pongola River catchment lies in Swaziland. The two rivers flow together in South Africa just before entering Mozambique as the Maputo River. Climate in the region can be described as subhumid to humid, but varies considerably. Mean annual rainfall ranges between 600 mm and 1 500 mm. Economic activity is diverse and includes rain fed and subsistence farming, irrigation, afforestation, eco-tourism, and heavy industries in the Richards Bay/Empangeni area. Water resources in the Upper Usutu, Mkuze and Mhlhatuze catchments have been well developed, while undeveloped potential exists in the Pongola and Mfolozi catchments. Ground water utilisation in most parts of the water management area is relatively small, and can thus be developed further.

Fig D6: Base map of the Usutu to Mhlhatuze water management area



Strong interdependencies between surface and groundwater occur in many areas, with groundwater levels, together with surface flows, being particularly important to water balances in the ecologically sensitive coastal lakes and wetlands, some of which are internationally recognised conservation areas. Large quantities of water are transferred from the Upper Usutu to the Upper Vaal and Upper Olifants water management areas, and transfers are also made from the Thukela water management area to the Mhlhatuze sub-area.

The expectations are that little change will occur in the overall population in the water management area within the period under consideration. A decline in rural population will likely be balanced by a growth in urbanisation in the Richards Bay/Empangeni area. Growth in water requirements will be dictated by the level of industrial activity in the Richards Bay area, which is difficult to estimate.

D6.2 Key statistics relevant to the Usutu to Mhlatuze water management area

Tables D6.1 to D6.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Usutu to Mhlatuze water management area.

In contrast to the situation for the Komati River, little information is available concerning the portions of the Usutu and Pongola Rivers within Swaziland. No statistics in respect of Swaziland other than the mean annual runoff are therefore provided in the tables. The data is derived primarily from the standardised data base and different information may be available from other sources.

Table D6.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1, 2}
Upper Usutu ³	901	328
Pongola ⁴	1 344	200
Mkuze	635	218
Mfolozi	962	275
Mhlatuze	938	171
Total for WMA	4 780	1 192

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.
- 3) Excludes the Usutu River in Swaziland (MAR = 1 320 million m³/a).
- 4) Includes the Pongola and Ngwavuma Rivers in Swaziland (MAR = 213 million m³/a).

Table D6.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Upper Usutu	196	2	1	3	0	202
Pongola	616	8	21	0	0	645
Mkuze	15	12	6	0	0	33
Mfolozi	36	5	5	4	1	51
Mhlatuze	156	12	9	2	0	179
Total for WMA	1 019	39	42	9	1	1 110

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D6.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affore- station ⁴	Total local require- ments
Upper Usutu	13	8	5	0	0	43	69
Pongola	213	1	6	1	0	34	255
Mkuze	61	1	10	0	0	6	78
Mfolozi	51	12	11	4	0	2	80
Mhlatuze	94	28	8	86	0	19	235
Total for WMA	432	50	40	91	0	104	717

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D6.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Upper Usutu	202	0	69	114	19
Pongola	645	0	255	30	360
Mkuze	33	30	78	0	(15)
Mfolozi	51	0	80	18	(47)
Mhlatuze	179	58	235	0	2
Total for WMA	1 110	40	717	114	319

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D6.5 and D6.6.

Table D6.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Upper Usutu	203	0	74	114	15	0
Pongola	646	0	257	30	359	95
Mkuze	33	30	77	0	(14)	0
Mfolozi	51	0	79	18	(46)	15
Mhlatuze	180	58	241	0	(3)	0
Total for WMA	1 113	40	728	114	311	110

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation requirements.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of Embiane and Vaderland Dams. Additional potential may also be developed in the Upper Usutu catchment.

Table D6.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfer s out	Balance ³	Potential for develop- ment ⁴
Upper Usutu	205	0	79	114	12	0
Pongola	646	0	257	30	359	95
Mkuze	34	30	78	0	(14)	0
Mfolozi	54	0	86	18	(50)	15
Mhlatuze	185	58	312	0	(69)	0
Total for WMA	1 124	40	812	114	238	110

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and a high impact of economic development. Assumes no general increase in irrigation requirements.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of Embiane and Vaderland Dams. Additional potential may also be developed in the Upper Usutu catchment.

D6.2 Key elements of the broad strategic perspectives for the Usutu to Mhlatuze water management area

Substantial surplus yield is available from the Pongolapoort Dam and there is potential for further water resource development in the upper reaches of the Pongola River. Suitable land is available downstream of the Pongolapoort Dam and the development of irrigation farming could make a substantial contribution to rural development and poverty eradication. However, concerns exist about the possible environmental impacts of such a venture. Undeveloped potential in the upper reaches of the Pongola River could also be used to augment shortfalls in the Vaal River System. It is prudent to ensure that future opportunities in this respect are not forfeited by more immediate, but less beneficial developments.

Although a surplus is shown in Table D6.4 in respect of the Upper Usutu catchment as a whole, a deficit will actually be experienced at the dams after implementation of the Reserve whilst a surplus will still exist

downstream of the dams. As most of the yield from the Usutu dams is transferred to other water management areas, mainly for the strategic use of power generation, implementation of the Reserve could have significant impacts that may cascade down to other water management areas. Comprehensive implementation planning with respect to the Reserve will therefore be required.

The deficits reflected for the Mfolozi catchment is partly attributable to irrigation water requirements in excess of the yield, and partly due to the provision for the ecological component of the Reserve. The deficit shown in the Mkuze catchment is as a result of the provision for implementation of the Reserve, prior to which a surplus exists.

Of the mean annual runoff of 901 million m³/a originating from the upper Usutu River catchment, an estimated 592 million m³/a on average still flows into Swaziland. Of the mean annual runoff of 1 344 million m³/a arising in the Pongola River catchment, including that derived from the Swaziland catchment, it is estimated that 968 million m³/a on average currently flows into Mozambique.

A complex situation exists in the Mhlatuze catchment where current water use allowances for irrigation are well in excess of the actual quantity used. In the meantime water is transferred into the catchment from the Thukela water management area for urban and industrial use. Although the requirements for and availability of water in the sub-area as a whole are approximately in balance, some localised imbalances exist. Where necessary the situation will have to be rationalised by means of compulsory licensing, and transfer of water in the future will have to be optimised. Due consideration will also have to be given to the other options described in Section 2.5 for reconciling requirements and availability.

The following reservations will apply with respect to the Usutu to Mhlatuze water management area:

- Existing transfers from the Upper Usutu catchment to the Upper Vaal and Olifants water management areas up to the installed capacity of 114 million m³/a – reserved in the Usutu to Mhlatuze water management area.
- Current transfers from the Thukela River into the Mhlatuze sub-area of 40 million m³/a may be increased to a maximum of 94 million m³/a – reserved in the Thukela water management area.
Provisional planning has been completed for increasing water transfers from the Thukela to the Mhlatuze sub-area to about 252 million m³/a, which would be dependent on the construction of additional storage in the Thukela River. No reservation is required at this stage.
- The construction of new dams in the Pongola River catchment, as well as developments in the Upper Usutu catchment, which may negatively impact on possible further transfers of water to the Upper Vaal water management area and beyond, will be subject to approval at national level – reservations applicable to the Usutu to Mhlatuze water management area.
- Water resource developments that may impact on neighbouring countries will be subject to national authorisation – reservation applies to Usutu to Mhlatuze water management area.

D7 WATER MANAGEMENT AREA 7: THUKELA

D7.1 Introduction

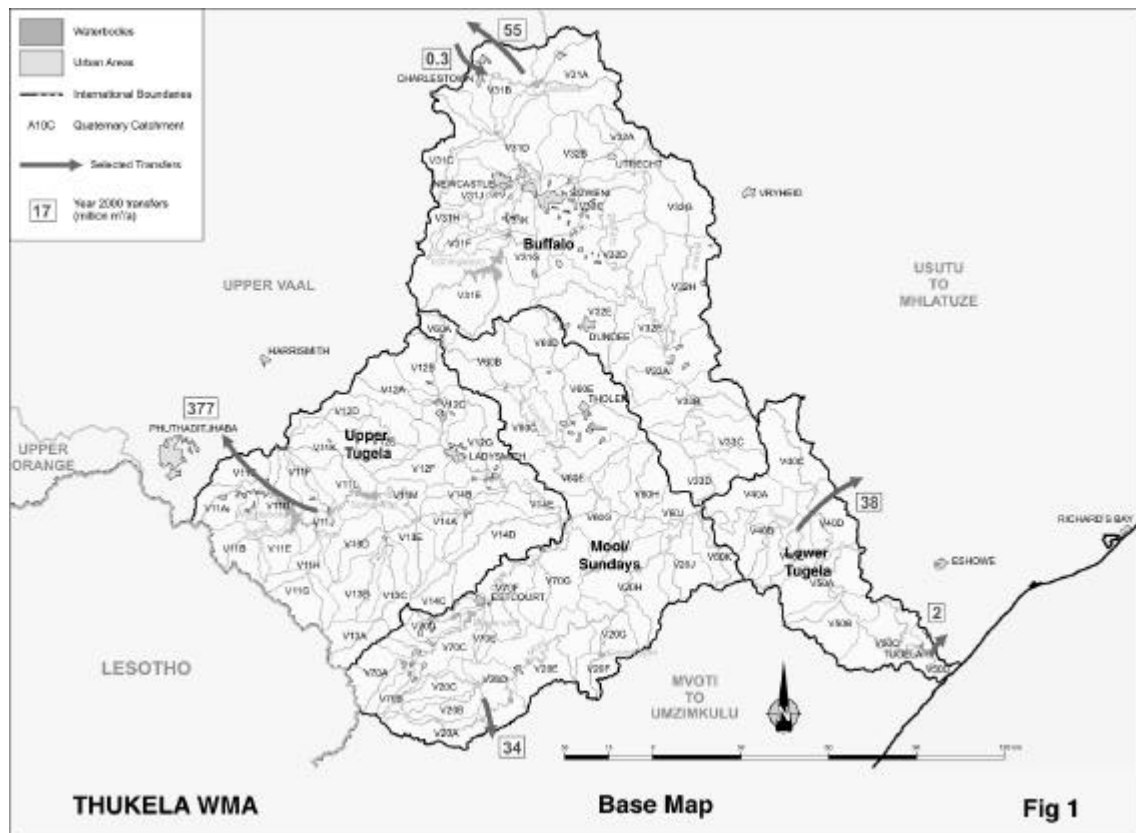
The Thukela water management area corresponds fully to the catchment area of the Thukela River and lies predominantly in the KwaZulu-Natal province. It is a funnel-shaped catchment, with several tributaries draining from the Drakensberg escarpment towards the Indian Ocean, as shown on the base map in Fig. D7. Parts of the Thukela water management area enjoy a high ecological status. It is characterised by mountain streams in the upper reaches, where several parks and conservation areas are located, as well as a number of important wetlands and vleis. Rainfall is highest near the mountains and along the coast, and the mean annual precipitation is in the range from 600 mm to 1 500 mm.

The Thukela water management area is predominantly rural in character with forestry, agriculture and eco-tourism as primary activities. Newcastle is the major industrial centre and the only other significant industrial activity at present is a large paper mill near Mandini.

Because of the high mean annual runoff and favourable topography, the Thukela basin offers some of the best opportunities for water resources development in South Africa. Although several large dams have already been constructed in the upper reaches of the Thukela River and on the main tributaries, substantial undeveloped resource potential remains. One of the largest inter-catchment transfer schemes in the country conveys water from the Upper Thukela River to the Upper Vaal water management area. Other water transfers are from the Mooi River to the Mgeni River in the Mvoti to Umzimkulu water management area, from the Buffalo River to the Upper Vaal water management area, and from the lower Thukela River to the Usutu to Mhlatuze water management area. Owing to the relatively well-watered nature of the catchment, only a small proportion of the water requirements is supplied from groundwater.

Expectations are that the area's population will remain relatively stable over the period of projection, with small growth or declines in localised areas. There are no major economic centres or stimuli in the water management area.

Fig. D7: Base map of the Thukela water management area



D7.2 Key statistics relevant to the Thukela water management area

Tables D7.1 to 7.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Thukela water management area. Data is derived primarily from the standardised data base. Different information may be available from other sources.

Table D7.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Upper Thukela	1 502	392
Mooi/Sundays	992	213
Buffalo	941	182
Lower Thukela	364	72
Total for WMA	3 799	859

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D7.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Upper Thukela	376	5	8	5	0	394
Mooi/Sundays	110	3	8	6	1	128
Buffalo	107	6	5	13	5	136
Lower Thukela	73	1	2	0	3	79
Total for WMA	666	15	23	24	9	737

- 1) After allowance for the impacts on yield of ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D7.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affore- station ⁴	Total local requirements
Upper Thukela	71	11	6	0	0	0	88
Mooi/Sundays	76	13	9	4	0	0	102
Buffalo	38	27	11	14	1	0	91
Lower Thukela	19	1	5	28	0	0	53
Total for WMA	204	52	31	46	1	0	334

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D7.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Upper Thukela	394	0	88	377	(71)
Mooi/Sundays	128	0	102	34	(8)
Buffalo	136	0	91	55	(10)
Lower Thukela	79	0	53	40	(14)
Total for WMA	737	0	334	506	(103)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to total transfers into and out of the WMA. The same applies to Tables D7.5 and D7.6.

Table D7.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Upper Thukela	396	0	94	377	(75)	380
Mooi/Sundays	131	0	107	34	(10)	218
Buffalo	136	0	92	55	(11)	0
Lower Thukela	79	0	54	40	(15)	0
Total for WMA	742	0	347	506	(111)	598

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumed no general increase in irrigation.
- 3) Brackets around numbers indicate negative balance.
- 4) Based on the construction of Jana, Mielietuin en Springgrove Dams.

Table D7.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Upper Thukela	401	0	104	377	(80)	380
Mooi/Sundays	140	0	129	34	(23)	218
Buffalo	155	0	133	55	(33)	0
Lower Thukela	80	0	54	40	(14)	0
Total for WMA	776	0	420	506	(150)	598

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of the Jana, Mielietuin en Springgrove Dams.

D7.3 Key elements of the broad strategic perspectives for the Thukela water management area

The resources of the Thukela River are largely used to support water requirements in other parts of the country, with close to 70 per cent of the current yield being transferred out of the water management area. There are no strong economic drivers in the water management area to stimulate development, while water resource development for the sole purpose of irrigation is unlikely to be economically viable. Considering the anticipated continued strong growth in water requirements in the Upper Vaal, Crocodile (West) and Marico, Mvoti to Mzimkulu and Usutu to Mhlatuze water management areas, all of which have insufficient own resources and already receive part of their requirements from the Thukela water management area. It would be prudent that future large-scale water resource developments in the Thukela basin be under control of the Minister to ensure the best development in the interest of the country. High value urban/industrial application of the Thukela's additional water resources would be the only use that would make such development viable, but it would have the subsidiary benefit of stimulating some concomitant local development.

The deficits indicated in Table D7.4 are all attributable to provisions made for implementation of the Reserve and do not reflect actual current shortages. Implementation of the Reserve should therefore be planned carefully as a priority and should form part of any future development planning. Due account also needs to be taken of the options for reconciling the requirements for and availability of water as described in Section 2.5.

A substantial portion of the water resources of the Thukela basin will be required for existing and future transfers to other water management areas. Reservations in the Thukela water management area for this purpose are:

- The transfer of a maximum of 630 million m³/a from the Upper Thukela River to the Upper Vaal water management area (equal to the current capacity). The average quantity transferred is about 530 million m³/a.
- The transfer of up to 55 million m³/a (current capacity) from the Assegai tributary of the Buffalo River to the Upper Vaal water management area.
- The transfer from the Mooi River to the Mgeni River in the Mvoti to Umzimkulu water management area up to the current installed capacity of 100 million m³/a and up to 136 million m³/a with the addition of new infrastructure.
- The current transfer of 40 million m³/a to the Usutu to Mhlatuze water management area, which may be increased to a maximum of 94 million m³/a.

Development of large new water resources infrastructure will be under control of the Minister, as this resource may be required to supply additional water to the Usutu to Mhlatuze, Mvoti to Mzimkulu and Upper Vaal water management areas.

D8 WATER MANAGEMENT AREA 8: UPPER VAAL

D8.1 Introduction

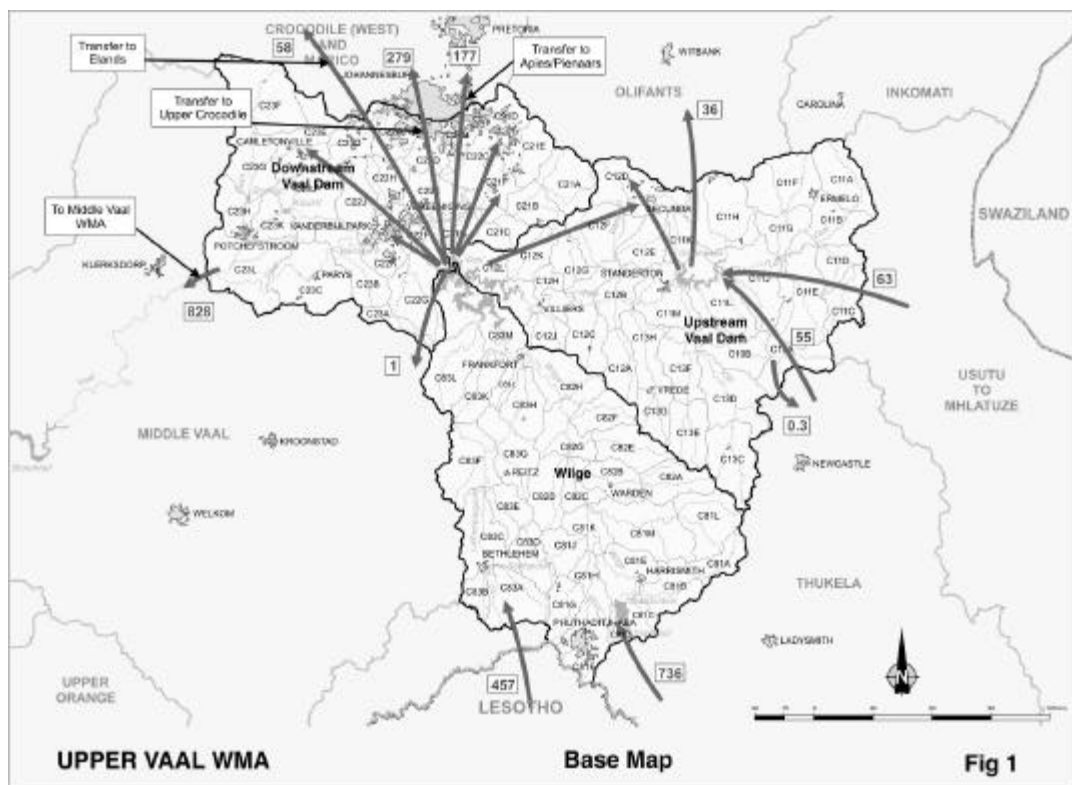
The Upper Vaal water management area lies in the eastern interior of South Africa. From a water resources management perspective it is a pivotal water management area in the country. Large quantities of water are transferred into the area from two neighbouring areas, as well as water sourced from the Upper Orange River via Lesotho. Similarly, large quantities of water are transferred out to three other water management areas, which are dependent on water from the Upper Vaal water management area to meet much of their requirements – see Fig. D8. The impacts of these transfers extend well beyond the four adjoining water management areas and eventually involve a total of ten water management areas and all the neighbouring countries of South Africa. Climate over the Upper Vaal water management area is fairly uniform, and the average rainfall varies between 600 mm and 800 mm per year.

Extensive urbanisation and mining and industrial activity, which relate to the rich gold and coal deposits in the area, occur in the northern part of the water management area. Similar mining and industrial development in the southern part of the Crocodile (West) and Marico water management area results in the two areas together producing 45 percent of South Africa's Gross Domestic Product (GDP). Economic activity in the remainder of the Upper Vaal water management area mainly relates to livestock farming and rain fed cultivation.

Because of the high level of urbanisation and economic activity in the area and its pivotal role as a water transfer point to other water management areas, water resources in the area are highly developed and regulated, and only marginal potential for further development remains. The total yield transferred into the catchment is in excess of 120 per cent of the yield from local surface resources, while virtually the same quantity of water is again transferred out of the area. Groundwater is mainly used for rural domestic needs and for stock watering, while a substantial quantity of water is also abstracted from dolomitic aquifers for urban use.

Projections show that population and economic growth will remain strong in the urban and industrialised parts of the water management area. A significant decline in population is, however, foreseen in the Qwa Qwa region in the southern extremity of the water management area.

Fig. D8: Base map of the Upper Vaal water management area



D8.2 Key statistics relevant to the Upper Vaal water management area

Tables D8.1 to 8.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Upper Vaal water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D8.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Wilge	868	116
Vaal Dam - upstream	1 109	126
Vaal Dam - downstream	446	57
Total for WMA	2 423	299

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D8.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground- water	Irrigation	Urban	Mining and bulk	
Wilge	46	4	2	7	0	59
Vaal Dam - upstream	154	8	3	11	8	184
Vaal Dam - downstream	399	20	7	325	138	889
Total for WMA	599	32	12	343	146	1 132

- 1) After allowance for the impacts on yield of the ecological component of Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D8.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local require- ments
Wilge	18	27	15	0	0	0	60
Vaal Dam - upstream	29	32	17	99	39	0	216
Vaal Dam - downstream	67	576	11	74	41	0	769
Total for WMA	114	635	43	173	80	0	1 045

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D8.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Wilge	59	0	60	0	(1)
Vaal Dam - upstream	184	118	216	67	19
Vaal Dam - downstream	889	1 224	769	1 343	1
Total for WMA	1 132	1 311	1 045	1 379	19

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to total transfers into and out of the WMA. The same applies to Tables D8.5 and D8.6.

Table D8.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local require- ments ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Wilge	58	0	56	0	2	0
Vaal Dam - upstream	184	118	256	74	(28)	50
Vaal Dam - downstream	987	1 513	957	1 561	(18)	0
Total for WMA	1 229	1 630	1 269	1 634	(44)	50

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on normal growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of Klip River Dam.

Table D8.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component / Sub-area	Local yield ¹	Transfers in	Local require- ments ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Wilge	64	0	78	0	(14)	0
Vaal Dam – upstream	190	118	272	74	(38)	50
Vaal Dam - downstream	1 232	1 513	1 391	2 067	(713)	0
Total for WMA	1 486	1 630	1 741	2 140	(765)	50

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of Klip River Dam.

D8.3 Key elements of the broad strategic perspectives for the Upper Vaal water management area

The Upper Vaal water management area is highly developed and impacted upon by human activity. The quantities of water transferred into and out of the area are largely dictated by the population needs and economic activity in this as well as similar needs in other recipient water management areas. It should be noted that the balance reflected in Table D8.4 for the sub area downstream of Vaal Dam will become a temporary surplus when the transfer of water from Mohale Dam in Lesotho is commissioned, and based on the assumption that all the transfers into the water management area are operated at nominal yield capacity. In practice, however, only the quantities of water actually required are transferred. (For simplicity, the transfers from Lesotho and the Upper Thukela are shown to be received in the sub-area downstream of Vaal Dam, where the water is actually used or from where it is transferred onwards). It is important to note that while large quantities of water are transferred into the Upper Vaal water management area, the yield available at Grootdraai Dam is limited by the existing infrastructure, and deficits may develop at that point.

Water quality in the Vaal River and in some tributaries downstream of Vaal Dam is seriously affected by urban and industrial and mining return flows and the intensive mining activity. The water resources are therefore carefully managed to maintain acceptable water quality standards. Particular attention is also to be given to the impacts that closure of mines may have on both surface and groundwater.

As the resources within the water management area essentially fully developed, future growth in the requirements for water will have to be met by increased water transfers from other water management areas. The successful implementation of water conservation and demand management measures are of particular importance in this area. The main water resource development options available in this regard are additional transfers from the Thukela water management area and the Orange River, the latter through additional transfers from Lesotho or from the Upper Orange water management area. Recent investigations have shown that a new dam on the Klip River could possibly be the best option to meet additional requirements in the sub-area upstream of Vaal Dam. Due consideration, however, must be given to all the options for reconciling water requirements and availability, as described in Section 2.5.

The following reservations apply with respect to the transfer of water into and out of the water management area, and the provision of water for future growth:

- The existing transfer of 491 million m³/a from Lesotho, which is to be increased to 835 million m³/a after the commissioning of Mohale Dam in Lesotho. – reserved by international agreement for use in and transfer from the Upper Vaal water management area.
- Existing transfers from the Thukela water management area up to the installed capacity of 630 million m³/a. The yield benefit in the Vaal System is 736 million m³/a – reserved in the Thukela water management area.
- Future large-scale water resources development on the Thukela River is reserved mainly for transfer to the Upper Vaal water management area. Current planning allows for an additional transfer of 475 million m³/a – reserved in the Thukela water management area.
- Existing transfer of 55 million m³/a from the Buffalo River in the Thukela water management area to the Upper Vaal water management area – reserved in the Thukela water management area.
- Transfers from the Usutu to Mhlatuze water management area at the current capacity of 63 million m³/a – reserved in the Usutu to Mhlatuze water management area.
- Existing transfers from the Upper Vaal water management area to the Olifants water management area of 36 million m³/a for power generation, plus an allowance of 38 million m³/a for future growth. (Included in Tables D8.3 to D8.6.) – reserved in the Upper Vaal water management area.
- Transfers from the Upper Vaal water management area through the Rand Water distribution system to meet requirements in the Crocodile (West) and Marico water management area which are in excess of the capacity of the local resources in the Crocodile (West) and Marico water management area. Currently this amounts to 514 million m³/a and is projected to increase to 723 million m³/a. As an upper high growth scenario, transfers may need to increase to 1 125 million m³/a. (Figures included in Tables D 8.5 and D 8.6.) – reserved in the Upper Vaal water management area.
- Releases from the Upper Vaal water management area along the Vaal River to users in the Middle Vaal and Lower Vaal water management areas to meet their realistic needs that cannot be supplied from own resources. Little change is expected from the current transfer of 828 million m³/a, although it may increase to about 910 million m³/a in 2025 under the high growth scenario – reserved in the Upper Vaal water management area.

- Current surplus transfer capacity into the Upper Vaal water management area is to be reserved for growth in urban, industrial and mining water requirements in the Upper Vaal and Crocodile (West) and Marico water management areas, and is not to be used for commercial irrigation.
- The allocation of surplus yield in the Upper Vaal water management area will be subject to national authorisation as it can be allocated to users in the Upper, Middle, Lower Vaal as well as Crocodile (West) and Marico and Olifants water management areas.
- The Upper Vaal water management area forms the central component of the Vaal River System, which extends over several water management areas. As water resources management in the Vaal River System impacts to some degree on the water quantity and quality in all the interlinked water management areas, management of the Vaal River System is to be controlled at a national level.

D9 WATER MANAGEMENT AREA 9: MIDDLE VAAL

D9.1 Introduction

The Middle Vaal water management area is situated in the Free State and North West Provinces in the central part of South Africa. It covers the middle reaches of the Vaal River, between the Upper Vaal and Lower Vaal water management areas (see Fig. D9). Rainfall is relatively low and ranges from 400 mm to 700 mm per year, while evaporation can be as high as 1 900 mm per year.

Fig. D9: Base map of the Middle Vaal water management area



There are no distinct geographic or topographic features and surface runoff is low. Activity in the water management area is typically extensive livestock farming and rain fed cultivation, with some irrigation farming. Economic activity, though, is dominated by gold mining in the vicinity of Klerksdorp and Welkom, which as a single sector contributes about 45 per cent of the Gross Domestic Product (GDP) in the water management area.

Dams have been constructed on all the main tributaries of the Vaal River. Any unregulated runoff is controlled by the Bloemhof Dam on the Vaal River in the Lower Vaal water management area immediately after the river exits the Middle Vaal water management area. No realistic potential for further development of surface water exists. Extensive use of groundwater for rural domestic and village supplies is made throughout the water management area. Large dolomitic aquifers are found in the northern part of the water management area, which extend into the adjoining water management areas and support large areas under irrigation.

Water along the Vaal River is highly saline and generally of poor quality as a result of the large quantities of effluent and urban runoff that is discharged into the river in the Upper Vaal water management area. Water quality is carefully managed by blending fresh water with the effluent.

Because of a decline in gold mining activity, a small decrease in population is projected for the area, with concomitant effects on economic activity. Little change in water requirements is therefore expected.

D9.2 Key statistics relevant to the Middle Vaal water management area

Tables D9.1 to 9.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Middle Vaal water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D9.1: Natural mean annual runoff and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Rhenoster-Vals	295	35
Middle Vaal	170	29
Sand-Vet	423	45
Total for WMA	888	109

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D9.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Rhenoster-Vals	22	12	3	7	0	44
Middle Vaal	(201)	25	3	15	16	(142)
Sand-Vet	112	17	10	7	1	147
Total for WMA	(67)	54	16	29	17	49

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D9.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Afforestation ⁴	Total local requirements
Rhenoster-Vals	26	20	8	0	0	0	54
Middle Vaal	33	35	13	48	0	0	129
Sand-Vet	100	38	11	38	0	0	187
Total for WMA	159	93	32	86	0	0	370

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D9.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Rhenoster-Vals	44	1	54	0	(9)
Middle Vaal	(142)	828	129	559	(2)
Sand-Vet	147	59	187	2	17
Total for WMA	49	829	370	502	6

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to total transfers into and out of the WMA. The same applies to Tables D9.5 and D9.6.

Table D9.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment
Rhenoster-Vals	44	1	53	0	(8)	0
Middle Vaal	(136)	837	142	560	(1)	0
Sand-Vet	147	59	187	2	17	0
Total for WMA	55	838	382	503	8	0

- 1) Based on existing infrastructure and under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on normal growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation requirements.
- 3) Brackets around numbers indicate a negative balance.

Table D9.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component / Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment
Rhenoster-Vals	49	2	65	0	(14)	0
Middle Vaal	(131)	910	152	628	(1)	0
Sand-Vet	149	72	200	2	19	0
Total for WMA	67	911	417	557	4	0

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation requirements.
- 3) Brackets around numbers indicate a negative balance.

D9.3 Key elements of the broad strategic perspectives for the Middle Vaal water management area

The Middle Vaal water management area is dependent on releases from the Upper Vaal water management area for meeting the bulk of the water requirements of its urban, mining and industrial sectors. Releases from the Upper Vaal water management area in support of the Lower Vaal water management area are transferred via the Middle Vaal water management area to the Bloemhof Dam, which is the uppermost control structure in the Lower Vaal area. Management of water quantity and quality in the Middle Vaal water management area is therefore integrally linked to both the Upper Vaal and Lower Vaal water management areas and commensurate management approaches will have to be followed in these water management areas. It is appropriate therefore that these aspects are managed at a national level.

The negative contribution from surface resources in the Middle Vaal sub-area, as reflected in Table D9.2, is a result of evaporation losses along this reach of the Vaal River being in excess of the yield from local tributaries. Owing to the intermittent nature of flow in the tributary rivers, provision for the ecological component of the Reserve has relatively little impact on the yield from the Rhenoster/Vals and Sand/Vet sub-areas.

Since no meaningful growth in requirements is foreseen in this water management area, the main issue of concern will be the management of water quality, which could be severely affected by further urban and industrial development in the Upper Vaal water management area, where the main sources of impact on water quality are located.

Due consideration must also be given to the implementation of appropriate demand management measures and to ensuring the most beneficial use of water.

The following quantities of water need to be reserved for transfers in to and out of the Middle Vaal water management area:

- Transfers from the Upper Vaal water management area for use in the Middle Vaal and Lower Vaal water management areas. Currently this amounts to 828 million m³/a and may under a high growth scenario increase to 910 million m³/a – reserved in the Upper Vaal water management area.
- Transfers from the Middle Vaal water management area to the Lower Vaal water management area. The current volume is 500 million m³/a, which under a high growth scenario may increase to about 555 million m³/a – reserved in the Middle Vaal water management area.
- Small existing transfers for domestic use from Vaal Dam in the Upper Vaal water management area to Heilbron in the Middle Vaal water management area – reserved in the Upper Vaal water management area.
- Small existing transfers for domestic use from Erfenis Dam in the Middle Vaal water management area to users in the Upper Orange water management area – reserved in the Middle Vaal water management area.

D10 WATER MANAGEMENT AREA 10: LOWER VAAL

D10.1 Introduction

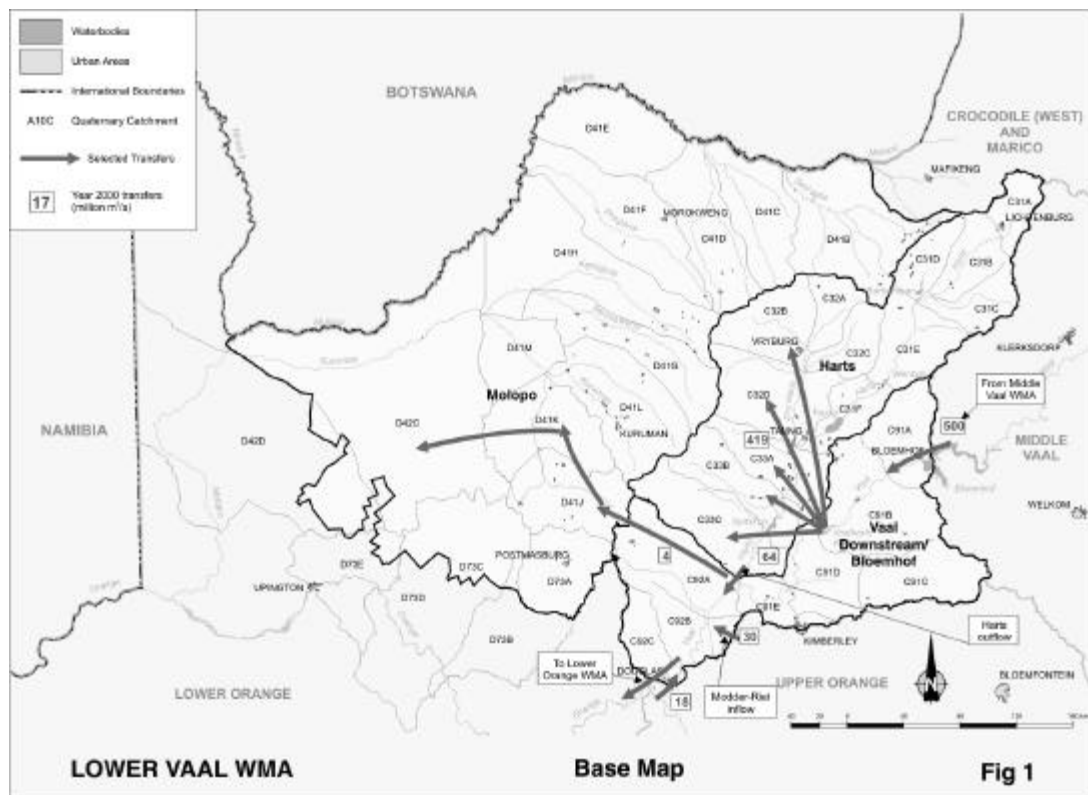
The Lower Vaal water management area lies in the north-western part of South Africa and borders on Botswana in the north. Climate in the region is semi-arid to arid, with rainfall ranging from 500 mm to as low as 100 mm per year and evaporation reaching 2 800 mm per year towards the west. Streamflow characteristics are distinctly different for the three sub-areas shown on Fig. D10. Flow in the Vaal River is perennial, fed by high rainfall and regulation upstream, the Harts River is characterised by highly intermittent runoff, and the Molopo and Kuruman Rivers are endorheic and typically cease to flow after some distance due to infiltration into the river bed and evaporation.

Iron ore, diamonds and manganese are mined in the water management area. Farming activity ranges from extensive livestock production and rain fed cultivation to intensive irrigation enterprises at Vaalharts. Kimberley, which straddles the divide between the Lower Vaal and Upper Orange water management areas, is the largest urban centre in the area.

Utilisable surface water resources in the water management area are limited to those supplied by the Vaal and Harts Rivers, both of which are fully regulated. Barberspan, an off-channel pan in the upper reaches of the Harts River, is a Ramsar wetland site. More than 50 per cent of the yield from natural water resources in the tributary catchments within the water management area is supplied from groundwater. At Sishen, groundwater abstracted in the process of de-watering the mine is also used for water supply, although it is recognised as being controlled mining of groundwater. Other localised over-exploitation of groundwater occurs in some areas. Water quality is of special concern in the lower reaches of the Harts and the Vaal Rivers because of the high salinity of leach water from the Vaalharts irrigation scheme. To counter this problem, better quality water is transferred from the Orange River to the Douglas Weir in the lower reaches of the Vaal River for blending purposes.

There is limited potential for strong economic development in the region and future population projections show little change in the demographics of the water management area. Little change in water requirements is therefore foreseen.

Fig. D10: Base map of the Lower Vaal water management area



D10.2 Key statistics relevant to the Lower Vaal water management area

Tables D 10.1 to 10.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Lower Vaal water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D10.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Harts	138	15
Vaal d/s Bloemhof ³	43	5
Molopo	197 ⁴	29
Total for WMA	181	49

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.
- 3) d/s Bloemhof = downstream of the Bloemhof Dam.
- 4) Estimated runoff from catchment, which is lost through evaporation and infiltration before reaching the Orange River. This runoff therefore does not add to the total for the water management area.

Table D10.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Harts	51	40	45	0	0	136
Vaal d/s Bloemhof ²	(107)	54	7	0	0	(46)
Molopo	2	31	0	0	2	35
Total for WMA	(54)	125	52	0	2	125

- 1) After allowance for the impacts on yield of the ecological component of Reserve, river losses, alien vegetation, dryland agriculture and urban runoff.
- 2) d/s Bloemhof = downstream of the Bloemhof Dam.

Table D10.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local requirements
Harts	452	23	19	0	0	0	494
Vaal d/s Bloemhof ⁵	73	32	8	0	0	0	113
Molopo	0	13	17	6	0	0	36
Total for WMA	525	68	44	6	0	0	643

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.
- 5) d/s Bloemhof = downstream of the Bloemhof Dam.

Table D10.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Harts	136	419	494	62	(1)
Vaal d/s Bloemhof ³	(46)	609	113	422	28
Molopo	35	4	36	0	3
Total for WMA	125	548	643	0	30

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to total transfers into and out of the WMA. The same applies to Tables D10.5 and D10.6.
- 3) d/s Bloemhof = downstream of the Bloemhof Dam.

Table D10.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment
Harts	137	419	496	60	0	0
Vaal d/s Bloemhof ⁴	(45)	631	112	422	52	0
Molopo	35	4	34	0	5	0
Total for WMA	127	572	642	0	57	0

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a normal growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) d/s Bloemhof = downstream of the Bloemhof Dam.

Table D10.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment
Harts	137	419	504	52	0	0
Vaal d/s Bloemhof ⁴	(45)	697	158	422	72	0
Molopo	35	4	41	0	(2)	0
Total for WMA	127	646	703	0	70	0

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) d/s Bloemhof = downstream of the Bloemhof Dam.

D10.3 Key elements of the broad strategic perspectives for the Lower Vaal water management area

Irrigation dominates water requirements in the Lower Vaal water management area and represents 80 per cent of total water use. Virtually all of this use is concentrated in the Vaalharts irrigation scheme, which relies on Vaal River water transferred from the Upper Vaal and Middle Vaal water management areas. The Vaalharts irrigation scheme serves the purpose of beneficially utilising lower quality water discharged from the Upper Vaal water management area and thus prevents the build up of salinity in the lower reaches of the Lower Vaal water management area.

The total quantity of water transferred into the Lower Vaal area represents about 80 percent of the local water requirements, and only return flows and spilling flood flows are discharged from the water management area. The positive yield balance shown in Table D10.4 with respect to the Vaal River downstream of the Bloemhof Dam is as a result of irrigation return flows in the lower reaches of the Vaal River.

The key issues with regard to water resources management in the water management area are the following:

- Operational management of water abstractions from the Vaal River is handled in close co-operation with the Middle Vaal and Upper Vaal Catchment Management Agencies to ensure the efficient overall management of the Vaal River System and efficient flood control in the Orange-Vaal system.
- Management of water quality in the Vaal and Harts Rivers.
- Management of groundwater, both from an abstraction and a recharge perspective, to ensure sustainability of use.

Due consideration is also to be given to the implementation of appropriate demand management measures and to ensuring the most beneficial use of water.

Reservations will apply in respect of water transfers into and out of the Lower Vaal water management area.

- Currently 500 million m³/a is transferred from the Middle Vaal water management area to the Lower Vaal water management area and may as an upper scenario increase to about 555 million m³/a during the period of projection – reserved in the Middle Vaal water management area.
- A reservation also applies to the transfer of 18 million m³/a from the Upper Orange water management area to Douglas Weir in the Lower Vaal water management area – reserved in the Upper Orange water management area.

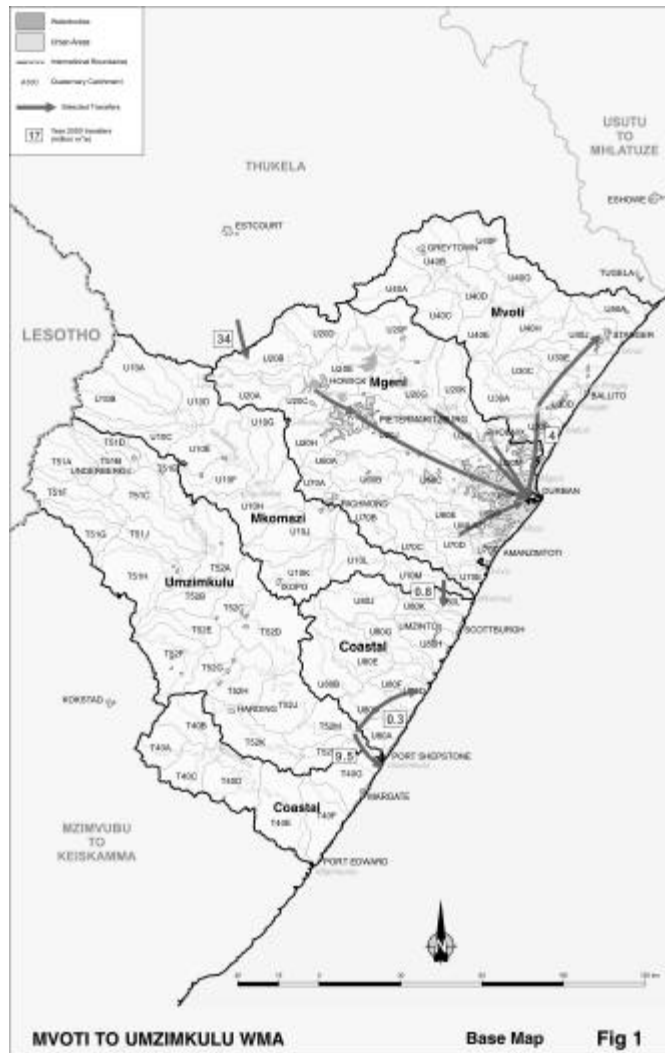
The Lower Vaal water management area forms part of the Vaal River System, which extends over several water management areas. As water resources management in this system impacts to some degree on water quantity and quality in all the interlinked water management areas, management of water resources in the Vaal River System is to be controlled at a national level.

D11 WATER MANAGEMENT AREA 11: MVOTI TO UMZIMKULU

D11.1 Introduction

The Mvoti to Umzimkulu water management area lies along the eastern coast of South Africa, predominantly within the province of KwaZulu-Natal, and borders on Lesotho to the west. It is situated in a humid part of the country with a mean annual precipitation of 800 mm to 1 500 mm. The terrain is rolling, with the Drakensberg escarpment as the main topographic feature. Several parallel rivers drain the water management area, two of which originate in the Drakensberg Mountains at the border with Lesotho. Small coastal streams also abound, as shown in Fig. D11. Many of the estuaries are still in a relatively natural state.

Fig. D11: Base map of the Mvoti to Umzimkulu water management area



Economic activity in the water management area is diverse. The rural areas are characterised by both subsistence and commercial farming, with extensive cultivation of sugar cane along the coast and commercial forests in the higher rainfall areas. The Durban metropolitan area is the second largest commercial and industrial nucleus in the country, and is surrounded by satellite developments along the coast and inland towards Pietermaritzburg.

Large differences are noticeable in the degree to which water resources have been developed in the water management area. The Mgeni River, which is the main source of water for the Durban/Pietermaritzburg area, is fully regulated by several large dams in the catchment and is augmented with transfers from the Thukela water management area. In contrast, the potential of the Mkomazi and Umzimkulu Rivers remains largely undeveloped and various degrees of development apply to the remainder of the surface resources in the water management area. Because of the perennial nature of streamflow in the water management area, surface water, which includes springflow, is generally used for rural water supplies and there is only minimal abstraction of groundwater.

Strong population growth is projected for the Mgeni sub-area, commensurate with the expected economic growth in the Durban/Pietermaritzburg area as well as a general tendency towards urbanisation. It is anticipated that population in the rural areas will remain relatively unchanged, although there could be localised decreases.

D11.2 Key statistics relevant to the Mvoti to Umzimkulu water management area

Tables D11.1 to 11.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Mvoti to Umzimkulu water management area. Data is derived primarily from the standardised data base. Different information may be available from other sources.

Table D11.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Mvoti	595	150
Mgeni	992	187
Mkomazi	1 080	295
Coastal	758	211
Umzimkulu	1 373	317
Total for WMA	4 798	1 160

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D11.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground- water	Irrigation	Urban	Mining and bulk	
Mvoti	68	1	8	5	4	86
Mgeni	316	1	6	52	1	376
Mkomazi	27	1	3	0	0	31
Coastal	11	2	1	0	0	14
Umzimkulu	11	1	3	0	1	16
Total for WMA	433	6	21	57	6	523

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D11.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local require- ments
Mvoti	76	9	10	11	0	8	114
Mgeni	63	378	12	4	0	47	504
Mkomazi	33	1	5	53	0	6	98
Coastal	10	19	10	1	0	1	41
Umzimkulu	25	1	7	4	0	3	40
Total for WMA	207	408	44	73	0	65	797

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D11.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Mvoti	86	0	114	4	(32)
Mgeni	376	38	504	0	(90)
Mkomazi	31	0	98	1	(68)
Coastal	14	11	41	0	(16)
Umzimkulu	16	0	40	10	(34)
Total for WMA	523	34	797	0	(240)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D11.5 and D11.6.

Table D11.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local require- ments ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Mvoti	90	0	122	4	(36)	47
Mgeni	404	38	705	0	(263)	90
Mkomazi	31	0	99	1	(69)	481
Coastal	14	11	45	0	(20)	0
Umzimkulu	16	0	40	10	(34)	400
Total for WMA	555	34	1 011	0	(422)	1 018

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Hazelmere and Midmar Dams, and construction of the Impendle, Smithfield and iSitungo Dams.

Table D11.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local require- ments ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Mvoti	94	0	131	4	(41)	47
Mgeni	459	38	1 103	0	(606)	90
Mkomazi	31	0	100	1	(70)	481
Coastal	14	11	62	0	(37)	0
Umzimkulu	16	0	41	10	(35)	400
Total for WMA	614	34	1 437	0	(789)	1 018

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and a high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Hazelmere and Midmar Dams, and construction of the Impendle, Smithfield and iSitungo Dams.

D11.3 Key elements of the broad strategic perspectives for the Mvoti to Umzimkulu water management area

Water resource management in the Mvoti to Umzimkulu water management area is dominated by the Mgeni System, which serves the Durban/Pietermaritzburg area and its coastal environs. The requirements for water in this area already exceed its availability and further growth in requirements is anticipated. Deficits are also experienced in the Mvoti and Mkomazi sub-areas and parts of the Coastal sub-area. These deficits occur mainly during low-flow periods as a result of insufficient storage and will be exacerbated by implementation of the Reserve. The deficit shown in Table D11.4 for the Umzimkulu sub-area is also attributable to the provision for the Reserve, which is still to be implemented.

Water quality in the lower Mgeni River and in the Msunduze tributary is highly affected by urban return flows and wash-off from insufficiently serviced residential areas, a situation that is of particular concern.

Great success in reducing the requirements for water has already been achieved in the Durban metropolitan area by the application of water demand management and the increased re-use of effluent. Action is being taken to bring about further improvements. Other interventions that could be applied to ensure an adequate supply of water in the future are described in Section 2.5.

The following options are of specific relevance to the Mvoti to Mzimkulu water management area:

- Additional transfers of water from the Mooi River in the Thukela water management area. Plans have already been developed to increase the transfer capacity from the existing 100 million m³/a to 136 million m³/a by constructing the Springgrove Dam on the Mooi River and increasing the pumping capacity.
- Increased re-use of return flows from the Durban metropolitan area. Although about 15 per cent of the return flows are currently re-used, some indirectly or for environmental purposes, the bulk is still discharged to the ocean.
- The transfer of water from the Mkomazi River to the Mgeni River within the water management area. As a future option water may also be transferred from the Umzimkulu River.

In support of the first option a volume of 135 million m³ per year is reserved for transfer from the Mooi River in the Thukela water management area to the Mgeni River in the Mvoti to Umzimkulu water management area. The Springgrove Dam to be constructed on the Mooi River for the purpose of transferring water to the Mgeni River will therefore fall under national control – reserved in the Thukela water management area.

The Mkomazi River has been identified by planning studies as the most feasible next option for augmenting water supplies for the Durban/Pietermaritzburg area, and development of this river needs to be reserved for that purpose – reservation to apply within the Mvoti to Umzimkulu water management area.

D12 WATER MANAGEMENT AREA 12: MZIMVUBU TO KEISKAMMA

D12.1 Introduction

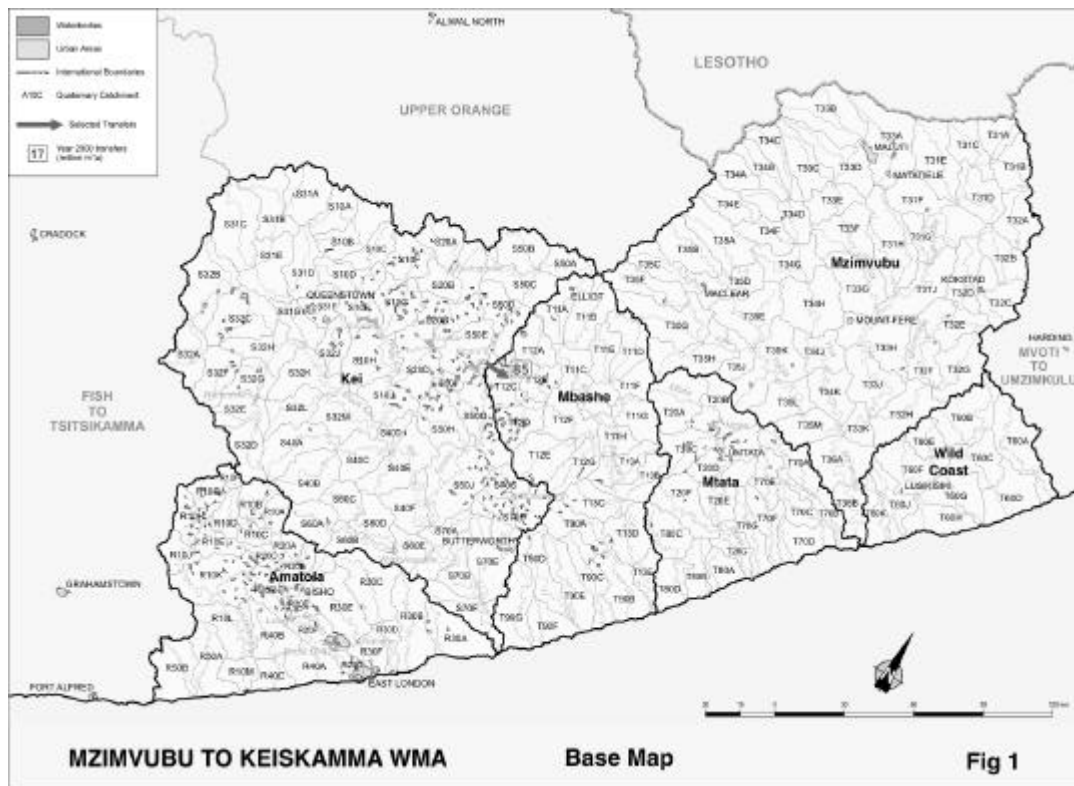
The Mzimvubu to Keiskamma water management area lies predominantly within the Eastern Cape Province and borders on Lesotho to the north (see Fig. D12). Climate over most of the area can be classified as sub-humid to humid, with rainfall in the range from 700 mm to nearly 1 500 mm/a, but reducing to as low as 400 mm/a in the west. The topography is rolling, with the highest points on the border with Lesotho, which also forms the divide with the Orange River catchment. Three main rivers flow from the inland divide to the coast, while smaller rivers and coastal streams abound. Many of the estuaries are still in a relatively natural state. The Mzimvubu River is the largest undeveloped river in South Africa.

Land use in the water management area is predominantly for livestock farming and subsistence agriculture. There are several irrigation developments, some of which are only partly operational, and timber is grown commercially in the higher rainfall areas. Economic activity is dominated by industrial development in the East London area, which is known for its automotive and textile industries.

The degree of water resources development in the water management area varies considerably. No noteworthy dams have been constructed in the Mzimvubu River catchment, where significant potential for water resource development remains. Development potential also exists in the Mbashe River. The Mtata River is well regulated by the Mtata Dam, while several dams have been constructed in the upper reaches of the Kei catchment and on the Buffalo River. Three small hydro-electric developments are in operation on the Mbashe and Mtata Rivers. Although inter-catchment transfers of water take place within the water management area, there are no inter-water management area transfers.

A moderate growth in population is expected for the East London/Bisho region (Amatola sub-area), while the area's rural population is projected to decline after the year 2005. Little change in the total population of the water management area is thus foreseen. Potential for economic development exists mainly in the East London/Bisho industrial zone, with tourism and commercial forestry as possible additional stimulants.

Fig. D12: Base map of the Mzimvubu to Keiskamma water management area



D12.2 Key statistics relevant to the Mzimvubu to Keiskamma water management area

Tables D 12.1 to 12.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Mzimvubu to Keiskamma water management area. Data is derived primarily from the standardised data base. Different information may be available from other sources.

Table D12.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1, 2}
Mzimvubu	2 897	338
Mtata	836	163
Mbashe	1 126	203
Kei	1 027	154
Amatola	559	116
Wild Coast	796	148
Total for WMA	7 241	1 122

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D12.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Mzimvubu	84	3	2	2	0	91
Mtata	129	1	0	6	0	136
Mbashe	112	1	0	1	0	114
Kei	325	14	14	6	0	359
Amatola	122	1	2	24	0	149
Wild Coast	4	1	0	0	0	5
Total for WMA	776	21	18	39	0	854

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D12.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local requirements
Mzimvubu	15	6	9	0	0	3	33
Mtata	4	15	5	0	0	29	53
Mbashe	3	2	6	0	0	0	11
Kei	135	18	10	0	0	11	174
Amatola	33	57	5	0	0	4	99
Wild Coast	0	1	3	0	0	0	4
Total for WMA	190	99	38	0	0	47	374

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D12.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Mzimvubu	91	0	33	0	58
Mtata	136	0	53	0	83
Mbashe	114	85	11	0	188
Kei	359	0	174	85	100
Amatola	149	0	99	0	50
Wild Coast	5	0	4	0	1
Total for WMA	854	0	374	0	480

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D12.5 and D12.6.

Table D12.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Mzimvubu	91	0	34	0	57	1 200
Mtata	141	0	61	0	80	45
Mbashe	115	85	10	0	190	65
Kei	360	0	179	85	96	135
Amatola	159	0	125	0	34	55
Wild Coast	5	0	4	0	1	0
Total for WMA	871	0	413	0	458	1 500

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of a number of dams within the WMA.

Table D12.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Mzimvubu	92	0	35	0	57	1 200
Mtata	138	0	54	0	84	45
Mbashe	115	85	10	0	190	65
Kei	362	0	185	85	92	135
Amatola	174	0	161	0	13	55
Wild Coast	5	0	4	0	1	0
Total for WMA	886	0	449	0	437	1 500

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of a number of dams within the WMA.

D12.3 Key elements of the broad strategic perspectives for the Mzimvubu to Keiskamma water management area

From the reconciliation in Table D12.4 it appears that sufficient yield is available to meet all existing requirements for water. However, with most of the rural and village requirements for water being supplied from unregulated run-of-river yields, implementation of the ecological component of the Reserve may result in the occurrence of dry-season deficits. These will probably manifest themselves as insufficient ecological flows because of preference to be given to basic human needs and are not reflected in the annual average figures in the table. Careful investigation and judicious implementation of the Reserve is therefore required.

Similarly, the surplus shown for the Amatola sub-area masks the deficits experienced in the Buffalo River catchment. Serious water quality problems are also experienced along the lower reaches of the Buffalo

River, which are largely attributable to industrial effluent discharges into the river. As the Buffalo River, together with the Nahoon and Kubusi Rivers, are the main sources of water for the important East London/Bisho area, management of both water quantity and quality in the Buffalo River should be a special priority in this water management area.

Where deficits are experienced in localised cases, the options described in Section 2.5 for reconciling the requirements for and availability of water should be considered.

Other issues that should receive specific consideration are:

- refurbishment and improved utilisation of irrigation schemes that have fallen into disrepair; and
- the position with respect to insufficient streamflow measurement in many parts of the water management area.

In view of the fact that the Mzimvubu River is the largest undeveloped water resource in the country, the benefits to be derived from the development of this river will potentially be of national importance. It is prudent, therefore, for large-scale development of the Mzimvubu River to be made subject to authorisation at national level. With appropriate planning, new dams for hydropower generation and irrigation, for example, can be located and designed in such a way as to permit the abstraction of water for transfer to other water management areas. The possibility of such future developments of national importance should not be jeopardised unduly by other developments in the interim – reservation with respect to large-scale development of the Mzimvubu River therefore applies to the Mzimvubu to Keiskamma water management area.

D13 WATER MANAGEMENT AREA 13: UPPER ORANGE

D13.1 Introduction

The Upper Orange water management area lies in the centre of South Africa and extends over the southern Free State and parts of the Eastern and Northern Cape provinces. It borders on Lesotho to the east, where the Orange River originates as the Senqu River (refer to Fig. D13). Draining the Highlands of Lesotho, the Senqu River contributes close to 60 per cent of the surface water associated with the Upper Orange water management area. The climate varies considerably over the region and rainfall ranges from over 1 000 mm/a in the foothills of the mountains to as little as 200 mm/a in the west. Vegetation is mainly grassland. Extensive sheep and cattle farming is characteristic throughout the area. Some dry-land cultivation occurs where the rainfall and soils are favourable, but sizeable areas are under irrigation below the main storage dams. Bloemfontein, as an administrative and commercial centre, is the only large urban development in the water management area.

Water resources management in the area mainly revolves around the Orange River. Two of the highest dams in Africa have been constructed in the Orange (Senqu) catchment in Lesotho for the purpose of transferring water to the Upper Vaal water management area. The Gariep and Vanderkloof Dams in the water management area, where the two largest conventional hydropower installations in the country are located, also command the two largest storage reservoirs in South Africa. From the Gariep Dam a major inter-water management area transfer occurs via the 80 km long Orange-Fish Tunnel to the Fish to Tsitsikamma water management area. A significant portion of the yield of the Orange River is also released down the river for use in the Lower Orange water management area and by Namibia. In total, close to 70 per cent of the yield realised in the Upper Orange water management area and in Lesotho is used in other water management areas. Even so, potential still exists for further large-scale development of the Orange River, with the most attractive sites for new dams being at the confluence of the Orange and Kraai Rivers, and at Mashai in Lesotho. The Modder and Riet tributaries have been fully developed. Significant quantities of groundwater are used in parts of the water management area.

Demographic projections show a small decline in rural population. As the expectations are that this will be balanced by population growth in the Bloemfontein area, little change in the total population of the water management area is anticipated within the period of projection. There are no strong stimulants for economic growth in the area.

Fig. D13: Base map of the Upper Orange water management area



D13.2 Key statistics relevant to the Upper Orange water management area

Tables D13.1 to 13.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Upper Orange water management area. Data is derived primarily from the standardised data base. Different information may be available from other sources.

Table D13.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Senqu Lesotho	4 012	933
Caledon Lesotho	753	92
Caledon RSA	650	90
Kraai	956	158
Riet / Modder	407	45
Vanderkloof	203	31
Total for WMA	6 981	1 349

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with the impact on yield being a portion of this.

Table D13.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Senqu Lesotho	523	0	0	0	0	523
Caledon Lesotho	28	1	0	2	0	31
Caledon RSA	167	5	4	2	0	178
Kraai	34	10	0	0	0	44
Riet / Modder	85	6	13	33	0	137
Vanderkloof	3 474	43	17	0	0	3 534
Total for WMA	4 311	65	34	37	0	4 447

- 1) After allowance for impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D13.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local requirements
Senqu Lesotho	8	2	13	0	0	0	23
Caledon	12	22	6	0	0	0	40
Caledon RSA	88	4	13	0	0	0	105
Kraai	84	6	13	0	0	0	103
Riet / Modder	252	87	10	2	0	0	351
Vanderkloof	336	5	5	0	0	0	346
Total for WMA	780	126	60	2	0	0	968

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D13.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Senqu Lesotho	523	0	23	491	9
Caledon Lesotho	31	0	40	0	(9)
Caledon RSA	178	0	105	59	14
Kraai	44	0	103	0	(59)³
Riet / Modder	137	242	351	29	(1)
Vanderkloof	3 534	0	346	2 809	379
Total for WMA	4 447	2	968	3 148	333

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D13.5 and D13.6.
- 3) The negative balance for the Kraai sub-area is as a result of irrigation requirements that are not fully supplied from run-of-river.

Table D13.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Senqu Lesotho	867	0	23	835	9	300
Caledon	30	0	40	0	(10)	0
Caledon RSA	273	0	104	118	51	0
Kraai	45	0	138	0	(93)	0
Riet / Modder	160	301	410	52	(1)	0
Vanderkloof	3 359	0	347	2 883	129	600
Total for WMA	4 734	2	1 062	3 589	85	900

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on growth in water requirements as a result of population growth and general economic development. Water for a 5 000 ha expansion in irrigation farming in the Fish to Tsitsikamma WMA and an expansion of 4 000 ha each in the Upper and Lower Orange WMAs is to be sourced from the Upper Orange WMA. The water requirements of 36 million m³/a and 54 million m³/a for the Upper and Lower Orange respectively are provisionally allowed for under the Kraai sub-area and as a transfer from the Vanderkloof sub-area.
- 3) Brackets around numbers indicate a negative balance.
- 4) The potential of 900 million m³/a could be realised by constructing the Mashai Dam in Lesotho in conjunction with the Boskraai Dam at the confluence of the Orange and Kraai Rivers, or by constructing a larger Boskraai Dam on its own.

Table D13.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Senqu Lesotho	867	0	23	835	9	300
Caledon	30	0	40	0	(10)	0
Caledon RSA	274	0	106	171	(3)	0
Kraai	45	0	141	0	(96)	0
Riet / Modder	180	354	463	72	(1)	0
Vanderkloof	3 359	0	351	2 952	56	600
Total for WMA	4 755	2	1 124	3 678	(45)	900

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on growth in water requirements as a result of population growth and general economic development. Water for a 5 000 ha expansion in irrigation farming in the Fish to Tsitsikamma WMA and an expansion of 4 000 ha each in the Upper and Lower Orange WMAs is to be sourced from the Upper Orange WMA. The water requirements of 36 million m³/a and 54 million m³/a for the Upper and Lower Orange respectively are provisionally allowed for under the Kraai sub-area and as a transfer from the Vanderkloof sub-area.
- 3) Brackets around numbers indicate a negative balance.
- 4) The potential of 900 million m³/a could be realised by constructing the Mashai Dam in Lesotho in conjunction with the Boskraai Dam at the confluence of the Orange and Kraai Rivers, or by constructing a larger Boskraai Dam.

D13.3 Key elements of the broad strategic perspectives for the Upper Orange water management area

An apparent sizeable quantity of the yield of the Orange River is still unutilised, as shown for the Vanderkloof sub-area in Table D13.4. However, this will be substantially reduced once impoundment commences at the Mohale Dam in Lesotho. The deficits in some tributary sub-areas are as a result of provisions for the ecological component of the Reserve, which still needs to be implemented. Large potential for further development exists, partly in Lesotho and partly in the Vanderkloof sub-area. Key issues with regard to the management of water resources in the Upper Orange water management area will therefore relate to the allocation of the surplus that was available in 2000 and the realisation of development potential. These are highly dependent on developments in other water management areas, as well as in Lesotho and Namibia.

A major impact on the water management area is the Lesotho Highlands Water Project. Although South Africa and Lesotho have only committed to Phase 1 of the project, which includes the Katse and Mohale Dams and the Matsoku diversion, the Treaty between the countries provides for the possibility of further phases up to a maximum diversion capacity of 2 200 million m³/a. Because of the current dramatically lower population growth expectations for South Africa, combined with revised assessments of the hydrology and environmental water requirements, uncertainty exists about the feasibility of developing the Lesotho Highlands Water Project further. A final decision in this respect can only be taken after further investigations and in consultation with the other Orange River Basin countries. Another ongoing joint investigation concerns possible developments in the Caledon River catchment, which is shared by Lesotho and South Africa.

The development of 13 000 ha of new irrigated land for the purposes of rural development, poverty relief and the settlement of emerging farmers has in principle been sanctioned by the Minister of Water Affairs and Forestry. While these developments are to be located in the Upper Orange, Lower Orange and Fish to Tsitiskamma water management areas, most of the water will probably have to be sourced from the Upper Orange water management area. Other priorities are urban and industrial development in Bloemfontein/Botshabelo and the augmentation of supplies to the Port Elizabeth area in the Fish to Tsitsikamma water management area. Additional water may also have to be released from the Upper Orange water management area for use by Namibia. Water quality in the Riet River, as well as flood management in the Lower Orange water management area are also of importance. Although some surplus water is available in the Upper Orange water management area, this is likely to be fully taken up by the additional allowances for irrigation. Depending on the growth in requirements of other users, a deficit can easily result. Due consideration will therefore have to be given to appropriate demand management measures and to ensuring that the available water is used in the most beneficial manner.

Because of the Upper Orange water management area's central location and its linkages to other water management areas, much of the area's water resources are used in other water management areas. Accordingly specific reservations with regard to the use of water from the Upper Orange water management area are:

- The current transfer of 491 million m³/a from the Senqu River in Lesotho to the Upper Vaal water management area, which is to be increased to 835 million m³/a when Mohale Dam in Lesotho comes into operation by the year 2004 – reserved through Treaty with Lesotho.

In view of the reduced projections of water requirements from the Lesotho Highlands Water Project, it is imperative that the minimum quantity of water to be delivered, as specified in Annexure 2 of the Treaty on the Lesotho Highlands Water Project, is revised.

- In view of the reduced projections of water requirements from the Lesotho Highlands Water Project, it is imperative that the minimum quantity of water to be delivered, as specified in Annexure 2 of the Treaty on the Lesotho Highlands Water Project, is revised.
- The transfer of water to the Fish to Tsitsikamma water management area, up to the maximum capacity of the transfer tunnel of approximately 600 million m³/a, to serve current users as well as requirements for growth in the Port Elizabeth area – reserved in Upper Orange water management area.
- The transfer of 18 million m³/a from Marksdrift to Douglas Weir in the Lower Vaal water management area for water quality purposes – reserved in Upper Orange water management area.
- The release of water down the Orange River, currently about 2 035 million m³/a, to meet requirements in the Lower Orange water management area and for use by Namibia. A further 54 million m³/a for a

possible 4 000 ha new irrigation project in the Lower Orange water management area must also be allowed for – reserved in Upper Orange water management area.

- The agreement with Eskom in respect of water for hydropower generation must be honoured. Revisions to the agreement are, however, required to address the impact of hydropower generation on the flow regime in the river and the impact of further resource developments on power generation more adequately – agreement at national level with Eskom imposes reservation on Upper Orange water management area.
- Large-scale water resource developments on the Orange River as well as on the Caledon and Kraai tributaries, that may impact on the above or on neighbouring countries (including the Senqu in Lesotho), will be subject to authorisation at national level – reservation applies to Upper Orange water management area.
- The allocation of all surplus water in the Upper Orange water management area will resort under national control as this water may be allocated to users in the Upper Orange or other water management areas.

D14 WATER MANAGEMENT AREA 14: LOWER ORANGE

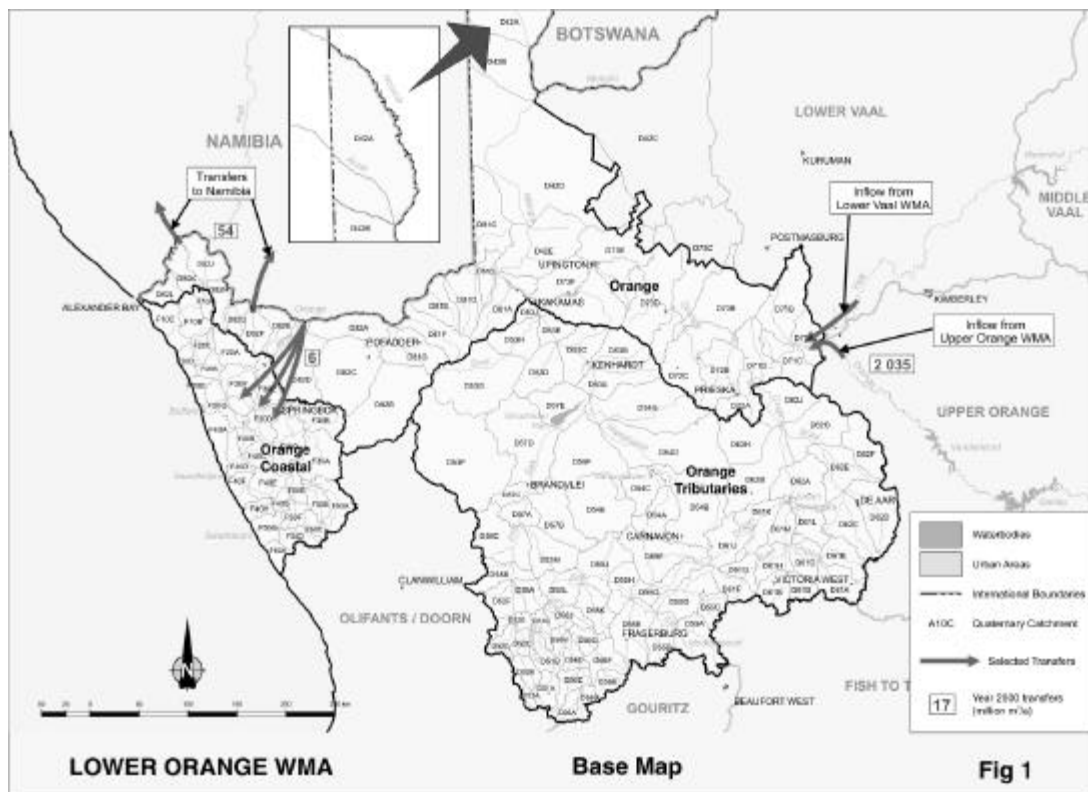
D14.1 Introduction

The geographic extent of the Lower Orange water management area largely corresponds to that of the Northern Cape Province. It is situated in the western extremity of South Africa and borders on Botswana, Namibia and the Atlantic Ocean (see Fig. D14). Climate over the region is harsh semi-desert to desert. Rainfall is minimal, ranging from 400 mm/a to a low of 20 mm/a and is characterised by prolonged droughts. With the exception of sparse and highly intermittent runoff from local tributaries and occasional inflows from the Fish River in Namibia, the Lower Orange water management area is totally dependent on flow in the Orange River from upstream water management areas. Because of the low rainfall, groundwater resources are also limited, although this source is well used for rural water supplies. Important conservation areas in the water management area include the Kgalagadi Transborder National Park, the Augrabies National Park, the Richtersveld National Park and a transboundary Ramsar wetland site at the Orange River mouth.

The largest contributions to the region's economy are made by mining and irrigated agriculture. Mining activities consist mainly of the extraction of alluvial diamonds and a variety of other mineral resources from locations both inland and along the coast. Extensive irrigation occurs along the Orange River, where the tendency is increasingly towards the growing of high-value orchard crops. Namibia also abstracts water from the river for domestic, mining and irrigation purposes. Sheep and other livestock farming is practised where the climate is favourable.

Water resources in the water management area are fully developed. Owing to the fact that water has to travel a distance of 1 400 km from the point of release at Vanderkloof Dam to the most downstream point of use, large operational and transmission losses are incurred in the process of ensuring that the requirements of users are met. Opportunity exists for this situation to be improved by constructing a new dam in the Lower Orange River for the purpose of providing re-regulation storage. Such a dam could serve a secondary function of regulating spills from dams in upstream water management areas. An unique development in the southern tributary catchments is the use of "soomwalle", or soil embankments that retain runoff from the land, as a means of rainfall harvesting.

Fig. D14: Base map of the Lower Orange water management area



Demographic projections show a steady population decline in the water management area over the next 25 years. Economic activity is likely to remain dependent on mining and irrigation farming in the foreseeable future, with modest contributions from eco-tourism. The potential also exists for the development of up to 4 000 ha of new irrigation land for the settlement of emerging farmers and as a means of poverty relief. Water for this purpose will be made available from the Upper Orange water management area.

D14.1 Key statistics relevant to the Lower Orange water management area

Tables D14.1 to 14.6 contain a breakdown of the data given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Lower Orange water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D14.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Orange ³	198	32
Orange Tributaries	280	35
Orange Coastal	24	2
Total for WMA	502	69

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.
- 3) Does not include the MAR of 466 million m³/a of the Fish River in Namibia.

Table D14.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield ¹
	Surface water	Ground-water	Irrigation	Urban	Mining and bulk	
Orange	(1 092)	9	96	1	0	(986)
Orange Tributaries	9	13	0	0	0	22
Orange Coastal	0	3	0	0	0	3
Total for WMA	(1 083)	25	96	1	0	(961)

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D14.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local require- ments
Orange	961	12	9	7	0	0	989
Orange Tributaries	16	8	7	0	0	0	31
Orange Coastal	0	5	1	2	0	0	8
Total for WMA	977	25	17	9	0	0	1 028

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally also available for other uses.)
- 4) Quantities refer to the impact on yield only.

Table D14.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in	Local requirements	Transfers out	Balance ¹
Orange	(986)	2 035	989	60	0
Orange Tributaries	22	0	31	0	(9)
Orange Coastal	3	6	8	0	1
Total for WMA	(961)	2 035	1 028	54	(8)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to total transfers into and out of the WMA. The same applies to Tables D14.5 and D14.6.

Table D14.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Orange	(981)	2 082	1 042	60	(1)	150
Orange Tributaries	22	0	29	0	(7)	0
Orange Coastal	2	6	8	0	0	0
Total for WMA	(957)	2 082	1 079	54	(8)	150

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on normal growth in water requirements as a result of population growth and general economic development. Includes a 4 000 ha increase in irrigated farming land in the Orange sub-area, which will require 54 million m³/a.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on construction of the Vioolsdrift Dam.

Table D14.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Orange	(980)	2 100	1 056	65	(1)	150
Orange Tributaries	22	0	33	0	(11)	0
Orange Coastal	2	11	13	0	0	0
Total for WMA	(956)	2 100	1 102	54	(12)	150

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Includes a 4 000 ha increase in irrigated farming land in the Orange sub-area, which will require 54 million m³/a.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on construction of the Vioolsdrift Dam.

D14.3 Key elements of the broad strategic perspective for Lower Orange water management area

The Lower Orange water management area is without doubt the water management area most impacted upon by upstream development, since it lies furthest downstream of five water management areas covering the Orange/Vaal basin. There are extensive inter-catchment transfers between most of these areas. Water use in Lesotho, transfers from Lesotho to the Upper Vaal water management area, the need to share the river's water with Namibia, and the negative yield of the river resulting from evaporation losses, as indicated in Table D14.4, are other factors to be taken into account. Furthermore, water quality along the Lower Orange River is affected by upstream developments and usage, while salinity in this stretch of the river is increased further by irrigation return flows within the water management area itself. Regular liaison with the other Orange River Basin water management areas on issues of common interest is therefore vital, as is the need for the Lower Orange to be managed in a systems context with the Upper Orange and Vaal River water management areas. Water quality management and management of the Orange River estuary in conjunction with Namibia need to receive special attention.

With over 90 per cent of water use in the water management area being for irrigation, it is prudent that specific attention is given to the improvement of irrigation practices, which is a continuous issue, and maximisation of the benefits derived from irrigation. Improved control over abstractions also has to be implemented. Of more localised importance is the development of a plan for the management of the "soomwalle" in view of the impact these have on water availability downstream.

The following reservations apply with regard to the management of the Lower Orange water management area:

- The transfer of water from the Upper Orange water management area, which currently amounts to about 2 035 million m³/a. The water requirement of 54 million m³/a for 4 000 ha of new irrigation development has been included in Tables D14.5 and D14.6 – reserved in Upper Orange water management area.
- The abstraction of water by Namibia and all water-related negotiations and agreements with Namibia are subject to national authorisation. The current arrangement is for Namibia to abstract a firm 50 million m³/a, plus an additional maximum quantity of 60 million m³/a under a temporary arrangement valid until 31st December 2007. However, in the year 2000 only a small portion of the additional allowance was abstracted – international agreement with Namibia imposes reservation on Lower Orange water management area.
- Flood management in the Orange/Vaal catchment will resort under national control because of the interdependence of the Orange/Vaal water management areas in this respect.
- Any new control infrastructure on the Orange River is subject to national authorisation because of its potential impact on Namibia and the requirements for managing the Orange River mouth. Apart from

this, new infrastructure across much of the lower Orange River will involve Namibian territory – reservation applies to lower Orange water management area.

D15 WATER MANAGEMENT AREA 15: FISH TO TSITSIKAMMA

D15.1 Introduction

The Fish to Tsitsikamma water management area is situated in the south-eastern part of South Africa, mainly within the Eastern Cape Province. The south-western part of the area is characterised by several mountain ranges lying parallel to the coast, with undulating terrain and localised massives inland. Climate over the water management area is strongly influenced by its location and topography. Typical arid Karoo climate prevails over most of the interior, where annual rainfall ranges from 600 mm to less than 200 mm. Small areas along the coast experience rainfall in excess of 1 000 mm/a. Several national parks and conservation areas are found in the water management area.

Sheep and mohair farming is the main land use, although intensive cultivation of irrigated land occurs along the main rivers. Subsistence farming is practised in the former Ciskei region and timber plantations occupy the high rainfall areas. The economy of the region is dominated by industrial activities in Port Elizabeth and Uitenhage.

Several dams have been constructed in the water management area, but because of the natural poor quality of water draining from the inland areas there is only limited potential for further water resources development. The waters of the Fish and Sundays Rivers (see Fig. D15) are of natural high salinity, and because of this large quantities of good quality water are transferred from the Orange River in the Upper Orange water management area for blending with local resources. Irrigation return flows reaching the main streams contribute to further deterioration of water quality. Groundwater is utilised extensively to supply towns and rural areas and over-exploitation occurs on a localised basis.

Economic growth in the water management area will for the foreseeable future be concentrated in the Port Elizabeth/Uitenhage area (the Algoa sub-area), although an increase in tourism is anticipated along the coast. A strong growth in population is projected for the industrial hub. Economic activity in the inland areas is expected to remain largely unchanged and a small decline in population is projected for these parts.

Fig. D15: Base map of the Fish to Tsitsikamma water management area



D15.2 Key statistics relevant to the Fish to Tsitsikamma water management area

Tables D15.1 to 15.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Fish to Tsitsikamma water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D15.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1, 2}
Fish	518	47
Bushmans	174	15
Sundays	280	20
Gamtoos	491	39
Algoa	147	15
Tsitsikamma	544	107
Total for WMA	2 154	243

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D15.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Fish	(4)	6	77	5	0	84
Bushmans	15	2	0	4	0	21
Sunday	61	16	22	2	0	101
Gamtoos	137	5	2	1	0	145
Algoa	10	6	1	6	0	23
Tsitsikamma	41	6	1	1	0	49
Total for WMA	260	41	103	19	0	423

- 1) After allowance for impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D15.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local requirements
Fish	453	12	6	0	0	2	473
Bushmans	11	9	2	0	0	0	22
Sunday	174	5	3	0	0	0	182
Gamtoos	104	3	3	0	0	1	111
Algoa	12	78	1	0	0	0	91
Tsitsikamma	11	5	1	0	0	5	22
Total for WMA	765	112	16	0	0	8	901

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D15.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Fish	84	575	473	117	69
Bushmans	21	1	22	0	0
Sunday	101	117	182	31	5
Gamtoos	145	0	111	12	22
Algoa	23	64	91	0	(4)
Tsitsikamma	49	0	22	22	0
Total for WMA	423	575	901	0	97

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D15.5 and D15.6.

Table D15.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Fish	95	603	525	145	28	25
Bushmans	25	1	29	0	(3)	0
Sunday	102	145	184	59	4	0
Gamtoos	146	0	112	12	22	60
Algoa	36	92	118	0	10	0
Tsitsikamma	52	0	24	22	6	0
Total for WMA	456	603	992	0	67	85

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Includes a provision of 50 million m³/a for a 5 000 ha increase in irrigated farming land in the Fish sub-area, which may have to be sourced from the Upper Orange water management area.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on construction of the Foxwood and Guerna Dams. Unquantified potential also exists in the Tsitsikamma sub-area.

Table D15.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Fish	97	653	530	195	25	25
Bushmans	25	1	33	0	(7)	0
Sunday	102	195	185	109	3	0
Gamtoos	146	0	113	12	21	60
Algoa	28	142	169	0	1	0
Tsitsikamma	52	0	27	22	3	0
Total for WMA	450	653	1 057	0	46	85

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on high growth in water requirements as a result of population growth and the high impact of economic development. Includes a provision of 50 million m³/a for a 5 000 ha increase in irrigated farming land in the Fish sub-area, which may have to be sourced from the Upper Orange water management area.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on construction of the Foxwood and Guerna Dams. Unquantified potential also exists in the Tsitsikamma sub-area.

D15.3 Key elements of the broad strategic perspectives for the Fish to Tsitsikamma water management area

The dominant feature in respect of water resource management in the Fish to Tsitsikamma water management area is the large transfer of water from the Upper Orange water management area into the catchments of the Fish and Sundays Rivers, equal to nearly 10 times the local surface water yield in these

sub-areas. Furthermore, about 96 per cent of the water used in these sub-areas is for irrigation, which is virtually fully supported by water from the Orange River. Since most of the irrigation canals are unlined, large distribution losses are experienced and this contributes to large volumes of irrigation return flows. Management of water quality in the Fish and Sundays Rivers is also a particular priority.

Currently all water requirements can be supplied in full, including the provisions for the ecological component of the Reserve. Most of the surpluses shown in Table D15.4 result from return flows being discharged to the ocean and of which the salinity may be too high for direct application to most uses without blending or treatment.

Further growth in water requirements in this water management area will be concentrated in the greater Port Elizabeth area. Options for reconciling water requirements and availability are described in Section 2.5. Priority is to be given to water demand management. The best options for augmenting supplies are an increase in the use of water from the Orange River, as well as the possible construction of a new dam on the Kouga River. The Minister has also given approval in principle for the development of a maximum of 5 000 ha new irrigation for poverty relief and the settlement of emerging farmers. Water for this development is to be sourced from the Upper Orange water management area and the water requirement has been included in Tables D15.5 and D15.6.

Key elements in respect of the management of water resources in the Fish to Tsitsikamma water management area therefore relate to:

- the efficient use of transferred water and the proper management of water quality;
- the achievement of improved irrigation efficiencies and the maximisation of the benefits derived; and
- ensuring sufficient future water supplies to the Port Elizabeth area.

A reservation will apply to the Upper Orange water management area with regard to the transfer of up to a maximum of 600 million m³/a of water from the Upper Orange water management area to serve current allocations in the Fish to Tsitsikamma water management area. Additional water from the Orange River will be subject to national authorisation. A reservation is also placed on the Fish to Tsitsikamma water management area with respect to the construction of the proposed Guerna Dam, which will be subject to national authorisation because of its inter-dependence with transfers from the Orange River.

D16 WATER MANAGEMENT AREA 16: GOURITZ

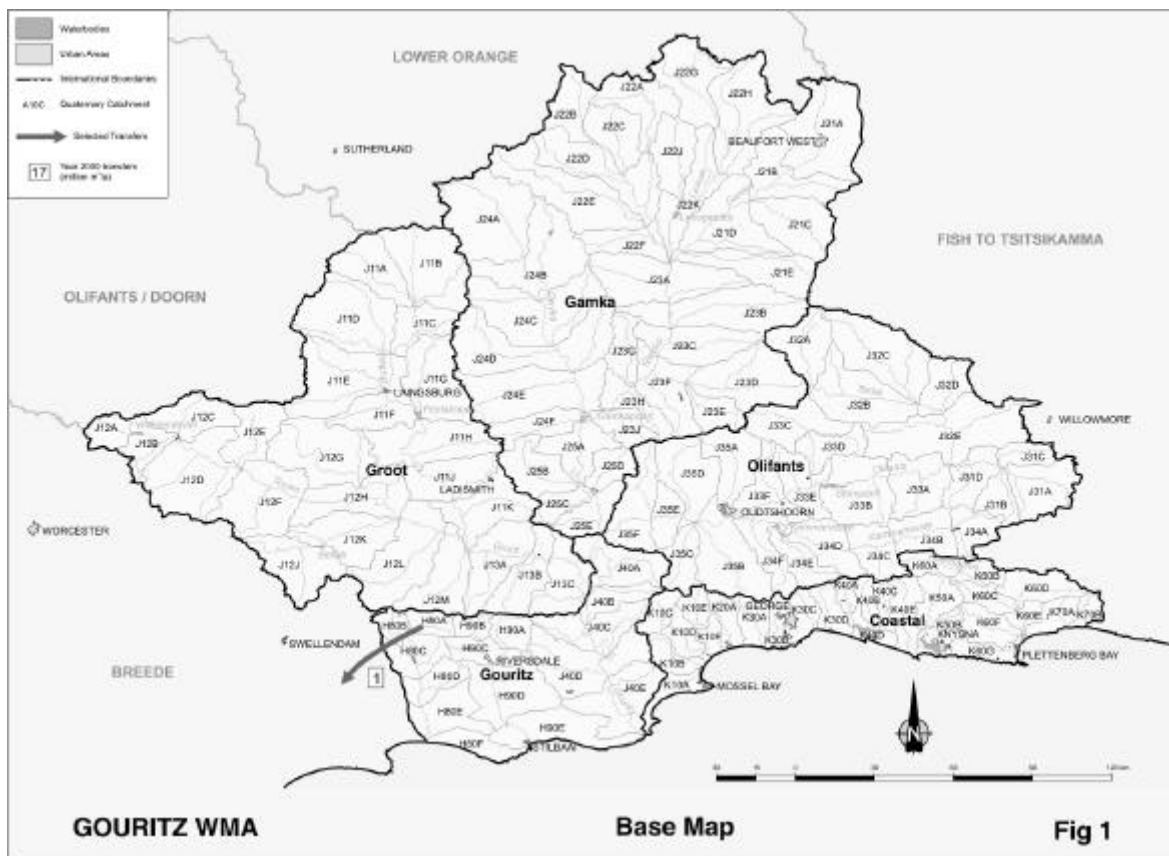
D16.1 Introduction

The Gouritz water management area is situated along the southern coast of South Africa and extends inland across the Little Karoo and into the Great Karoo. The area has two primary climatic regions that display distinctly different characteristics: the large arid inland Karoo area drained by the Gouritz River and the smaller humid strip of land along the coastal belt to the south of the Outeniqua Mountains which is drained by several small rivers (see Fig. D16). Rainfall ranges from less than 200 mm/a to over 1 000 mm/a. Economic activity is centred on sheep and ostrich farming in the arid areas, with extensive irrigation farming of lucerne, grapes and deciduous fruit in the Little Karoo, and on forestry, tourism and petrochemical industries in the coastal region. Indigenous forests, wetlands and estuaries of high conservation status are found in the humid areas. The water in the arid areas is naturally of high salinity as a result of the geology and climate.

Several dams control the Gouritz River and its tributaries. Dams have also been constructed on some of the coastal rivers, where potential for further regulation remains. A substantial proportion of the yield is from groundwater and there is strong interdependence between surface water and groundwater in the Olifants River valley. The potential of utilising the deep groundwater from the Table Mountain Group aquifers is being investigated. A small quantity of water - 0.7 million m³/a - is transferred to the Breede water management area for rural water supply.

A decline in population is foreseen in the inland areas, with little change in the requirements for water. However, a strong potential for growth, related to tourism, eco-tourism and possible further petrochemical developments based on offshore gas-field exploration exists in the coastal area.

Fig D16: Base map of the Gouritz water management area



D16.2 Key statistics relevant to the Gouritz water management area

Tables D16.1 to D16.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Gouritz water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D16.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1, 2}
Gamka	227	19
Groot	105	5
Olifants	229	17
Gouritz	347	56
Coastal	771	228
Total for WMA	1 679	325

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D16.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Gamka	24	24	0	0	0	48
Groot	19	23	0	0	0	42
Olifants	49	15	3	4	0	71
Gouritz	54	1	3	1	0	59
Coastal	45	1	2	1	6	55
Total for WMA	191	64	8	6	6	275

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D16.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local require- ments
Gamka	49	5	1	0	0	0	55
Groot	49	2	2	0	0	0	53
Olifants	62	10	2	0	0	0	74
Gouritz	51	3	3	0	0	1	58
Coastal	43	32	3	6	0	14	98
Total for WMA	254	52	11	6	0	15	337

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D16.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Gamka	48	0	55	0	(7)
Groot	42	0	53	0	(11)
Olifants	71	0	74	0	(3)
Gouritz	59	0	58	1	0
Coastal	55	0	98	0	(43)
Total for WMA	275	0	338	1	(64)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D16.5 and D16.6.

Table D16.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Gamka	48	0	55	0	(7)	0
Groot	43	0	52	0	(9)	0
Olifants	71	0	75	0	(4)	0
Gouritz	60	0	58	1	1	10
Coastal	56	0	116	0	(60)	100
Total for WMA	278	0	356	1	(79)	110

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Provisional estimates, subject to detailed investigations of environmental impacts and feasibility of developments.

Table D16.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Gamka	48	0	60	0	(12)	0
Groot	43	0	53	0	(10)	0
Olifants	78	0	90	0	(12)	0
Gouritz	61	0	61	1	(1)	10
Coastal	58	0	181	0	(123)	100
Total for WMA	288	0	445	1	(158)	110

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Provisional estimates, subject to detailed investigations of environmental impacts and feasibility of developments.

D16.3 Key elements of the broad strategic perspectives for the Gouritz water management area

At current levels of development, deficits occur in all the sub-areas with the exception of the lower Gouritz River (refer to Table D16.4). The deficits are mainly the result of irrigation requirements that are in excess of the available water, but where farming practices have been adapted accordingly. Particularly in the dry inland areas irrigation is at a very low assurance of supply and large areas are only cultivated in years when water is available. The deficit reflected for the coastal region is mostly attributable to the provision made for implementation of the Reserve. Under current conditions, without formal provision for the full Reserve, all urban/industrial uses can be fully supplied. However, the total irrigation requirements cannot always be supplied from run-of-river. Careful assessment of Reserve requirements and proper implementation planning is therefore necessary.

With future growth expected to be concentrated along the coastal belt, a strong growth in water requirements could be experienced in this region. Although significant potential exists for the further

development of surface resources, the occurrence of the resources in an area that is very important environmentally and ecologically sensitive is likely to be a limiting factor. Apart from the general options for reconciling water requirements and availability, as described in Section 2.5, the utilisation of groundwater from the Table Mountain Group aquifers, which currently spills directly into the ocean, may hold good promise and should be investigated further.

It is essential for the proper management of water resources in the water management area that the surface water/groundwater interrelationship in the Olifants River valley is clearly understood and quantified. Priority should be afforded to research in this area.

A reservation will apply to the Gouritz water management area with respect to the transfer of 0.7 million m³/a of water to the Breede water management area.

D17 WATER MANAGEMENT AREA 17: OLIFANTS/DOORN

D17.1 Introduction

The Olifants/Doorn water management area lies on the west coast of South Africa along the Atlantic Ocean and is shared by the Western Cape and Northern Cape provinces. It is one of the most diverse water management areas in the country with respect to its natural characteristics and water resources. Prominent topographic features are the Cederberg range and the narrow Olifants River valley. Rainfall varies from over 1 000 mm/a in the extreme south to less than 100 mm/a in the north, and a harsh and arid climate prevails over most of the water management area.

Virtually all the surface flow originates from the small, high-rainfall area around the Cederberg and is carried to the ocean by the Olifants River and its main tributary, the Doring River (see Fig. D17). A unique flow and water quality regime is created by the natural characteristics of the region, which provides a habitat for aquatic species of high conservation importance.

Fig D17: Base map of the Olifants/Doorn water management area



Economic activity in the water management area is centred on irrigated agriculture and 95 per cent of total water use is for irrigation. Intensive production of deciduous fruits, citrus and grapes occurs in the Koue Bokkeveld and along the Olifants River. The arid areas remote from the rivers are sparsely populated, with sheep and goat farming as the main activity. There are no large towns or urban areas in the water management area.

Surface water in the Olifants River is regulated by the Clanwilliam Dam and the Bulshoek Barrage. There are no large dams on the Doring River, although a large number of farm dams have been constructed on the upper tributaries. Significant potential for further water resource development exists, mainly on the Doring River, but is tempered by serious concerns about the potential impacts of such development on the sensitive ecosystems. Groundwater is used extensively in the water management area. In particular large quantities are abstracted for irrigation in the Sandveld area. The potential has also been identified for the possible abstraction of sizeable quantities of water from the deep Table Mountain Group aquifers.

Demographic projections show a future population decline in the water management area. Economic development is likely to be modest and will depend mainly on further irrigation development and the development of tourism.

D.17.2 Key statistics relevant to the Olifants/Doorn water management area

Tables D 17.1 to 17.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Olifants/Doorn water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D 17.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1, 2}
Koue Bokkeveld	279	29
Sandveld	60	8
Olifants	514	77
Knersvlakte	27	3
Doring	228	39
Total for WMA	1 108	156

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D 17.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Koue Bokkeveld	59	5	3	0	0	67
Sandveld	2	30	0	0	0	32
Olifants	196	4	19	2	0	221
Knersvlakte	1	3	0	0	0	4
Doring	8	3	0	0	0	11
Total for WMA	266	45	22	2	0	335

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D 17.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local requirements
Koue Bokkeveld	65	0	1	0	0	0	66
Sandveld	35	2	1	0	0	0	38
Olifants	240	4	2	0	0	1	247
Knersvlakte	3	0	1	3	0	0	7
Doring	13	1	1	0	0	0	15
Total for WMA	356	7	6	3	0	1	373

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower generally is available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D 17.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Koue Bokkeveld	67	0	66	0	1
Sandveld	32	0	38	0	(6)
Olifants	221	0	247	3	(29)
Knersvlakte	4	3	7	0	0
Doring	11	3	15	0	(1)
Total for WMA	335	3	373	0	(35)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown for the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to total transfers into and out of the WMA. The same applies to Tables D17.5 and D17.6.

Table D 17.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Koue Bokkeveld	67	0	66	0	1	0
Sandveld	32	0	38	0	(6)	0
Olifants	221	0	247	3	(29)	10
Knersvlakte	4	3	7	0	0	0
Doring	11	3	15	0	(1)	175
Total for WMA	335	3	373	0	(35)	185

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Clanwilliam Dam and construction of the Melkboom Dam.

Table D 17.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Koue Bokkeveld	67	0	65	0	2	0
Sandveld	32	0	42	0	(10)	0
Olifants	223	0	251	3	(31)	10
Knersvlakte	4	3	7	0	0	0
Doring	11	3	15	0	(1)	175
Total for WMA	337	3	380	0	(40)	185

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Clanwilliam Dam and construction of the Melkboom Dam.

D.17.3 Key elements of the broad strategic perspectives for the Olifants/Doorn water management area

The requirement for and availability of water are generally in balance over most of the water management area. Exceptions are in the Olifants River valley upstream of Clanwilliam Dam, where irrigation requirements have outstripped availability, and in the Sandveld area where some over-exploitation of groundwater is known to occur. The shortages in the Olifants River will be exacerbated by the implementation of the ecological component of the Reserve, which accounts for close to half of the deficit shown in Table D 17.4.

Options for reconciling water requirements and availability are described in Section 2.5. The following key aspects need to be considered in the management of the Olifants/Doorn water management area:

- The unique seasonal salinity regime of the Olifants/Doring River system and its importance to riverine species and fish breeding in the estuary. Much of the Doring River is still in a relatively pristine state and specific caution is warranted.
- Further research needs to be undertaken of the characteristics of the Sandveld aquifers to facilitate their proper management and to ensure that future priority requirements for water can be met.
- The deep Table Mountain Group aquifers may hold good potential for the abstraction of large quantities of groundwater. Many unknowns still exist, however, and these need to be clarified before any large-scale development can be embarked upon.

Water needs to be reserved in the Breede water management area with respect to the existing inter-water management area transfer to the Olifants/Doorn water management area. Currently this involves the transfer of 2.5 million m³/a to the Inverdoorn canal for irrigation purposes – reserved in the Breede water management area.

Considering the possible implications of climate change, and indications that its impacts may be manifest first in the south-western parts of the country, it is important that the hydrological parameters in the Berg and Breede water management areas are monitored closely. No development or investment decisions should be made that neglect to take into account the actual or potential affects of climatic change on water resources.

D18 WATER MANAGEMENT AREA 18: BREEDE

D18.1 Introduction

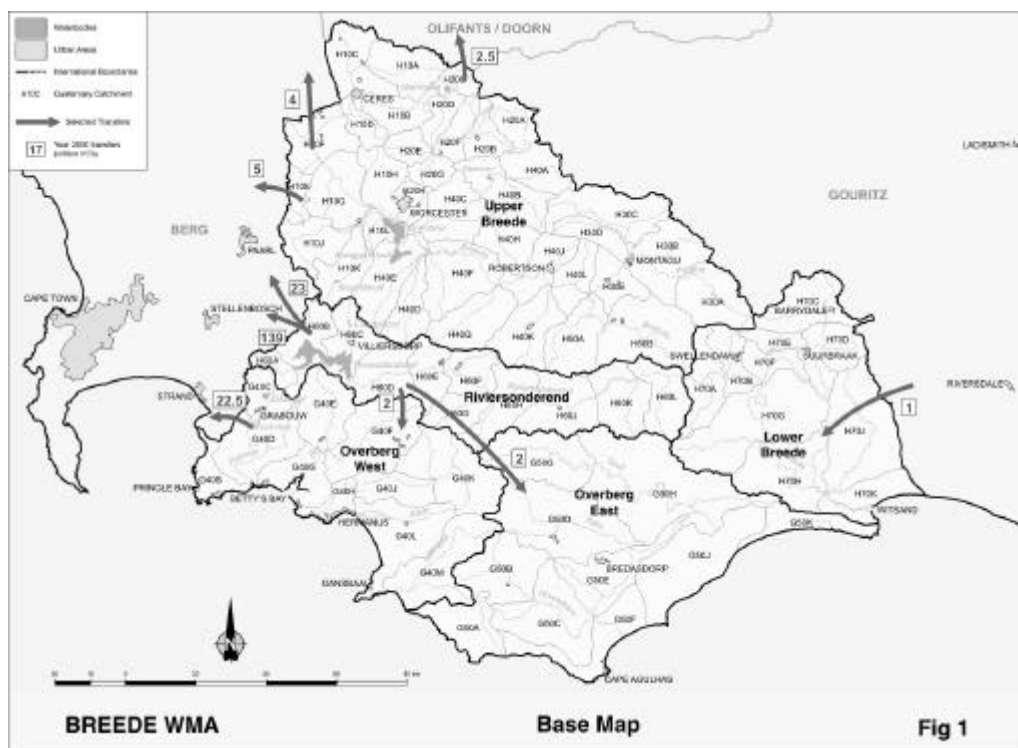
The Breede water management area is the southern-most water management area in South Africa and lies entirely in the Western Cape Province. The climate in the area varies considerably. In the western mountainous regions rainfall can exceed 1 500 mm/a, while in the lower eastern parts of the area the rainfall decreases to about 300 mm/a. Rainfall occurs during the winter. The greater part of the water management area is drained by the Breede River and its main tributary, the Riviersonderend River (see Fig. D18). Several small coastal rivers drain the southern part of the water management area, while vleis with no outflow to the sea are found in the south-east. The lower Palmiet River and the vlei areas are of high conservation importance.

The economy of the region is mainly agriculture-based, with tourism at resort towns along the coast. Extensive vineyards and fruit orchards are grown under irrigation, fed by water from mountain streams and the Breede River as well as groundwater. Dryland wheat is cultivated between the Riviersonderend and the coastal mountains, while livestock farming is practised throughout the region.

Several large dams, some of which are off-channel, and many farm dams have been constructed in the water management area. A unique feature is the operation of Theewaterskloof Dam. Water is transferred into the dam from the Berg water management area for seasonal storage and is then transferred back to that area during the dry season together with a larger quantity of additional water from the Breede water management area. Water is also transferred from the Palmiet River to the Berg water management area via the Palmiet Pumped Storage Scheme. Water in the lower Breede River is highly saline. This is attributable to natural mineralisation because of the geology of the region and irrigation return flows, which renders the water unfit for further irrigation use. Strong inter-dependence exists between groundwater and surface water in parts of the water management area. A sizeable potential for resource development remains in the area.

Demographic projections indicate population growth in the coastal areas, but a decline in inland areas, as a result of which the total population is anticipated to remain relatively constant. Because of the poor performance of the region's agricultural sector in recent times, no significant economic growth is foreseen over the short term, but this may change.

Fig. D18: Base map of the Breede water management area



D18.2 Key statistics relevant to the Breede water management area

Tables D18.1 to D18.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Breede water management area. Data is derived primarily from the standardised database. Different information may be available from other sources.

Table D18.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Upper Breede	1 212	178
Riviersonderend	460	65
Lower Breede	210	34
Overberg East	110	13
Overberg West	480	94
Total for WMA	2 472	384

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D18.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
Upper Breede	348	97	44	12	0	501
Riviersonderend	220	4	2	0	0	226
Lower Breede	30	4	1	1	0	36
Overberg East	1	1	0	0	0	2
Overberg West	88	3	6	2	0	99
Total for WMA	687	109	53	15	0	864

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D18.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Affores- tation ⁴	Total local requirements
Upper Breede	435	26	4	0	0	0	465
Rivieronderend	49	1	2	0	0	1	53
Lower Breede	28	2	1	0	0	0	31
Overberg East	0	2	2	0	0	0	4
Overberg West	64	8	2	0	0	5	79
Total for WMA	576	39	11	0	0	6	632

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D18.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Upper Breede	501	0	465	35	1
Rivieronderend	226	0	53	174	(1)
Lower Breede	36	33	31	0	38
Overberg East	2	2	4	0	0
Overberg West	99	2	79	23	(1)
Total for WMA	864	1	632	196	37

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to total transfers into and out of the WMA. The same applies to Tables D18.5 and D18.6.

Table D18.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Upper Breede	503	0	467	35	1	79
Riviersonderend	227	0	52	174	1	24
Lower Breede	36	33	31	0	38	12
Overberg East	3	2	3	0	2	0
Overberg West	100	2	83	23	(4)	9
Total for WMA	869	1	636	196	38	124

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumed no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of various schemes in the Breede WMA (Mitchells Pass diversion, Upper Molenaars diversion, Wit River Dam, the raising of the Buffeljags Dam, small schemes in the Breede catchment and Campanula Dam on the Palmiet River).

Table D18.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers In	Local requirements ²	Transfers out	Balance ³	Potential for development ⁴
Upper Breede	525	0	513	11	1	79
Riviersonderend	228	0	54	173	1	24
Lower Breede	38	8	34	0	12	12
Overberg East	3	2	7	0	(2)	0
Overberg West	103	2	95	23	(13)	9
Total for WMA	897	1	703	196	(1)	124

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the construction of various schemes in the Breede WMA (Mitchells Pass diversion, Upper Molenaars diversion, Wit River Dam, the raising of the Buffeljags Dam, small schemes in the Breede catchment and Campanula Dam on the Palmiet River).

D18.3 Key elements of the broad strategic perspectives for the Breede water management area

In general, there is sufficient yield available in the Breede water management area to meet all existing water requirements. Small surpluses currently exist in the Upper Breede and Riviersonderend catchments, but will be taken up with the implementation of the Reserve. Substantial potential for further water resources development exists.

With over 90 per cent of water used in the area being for irrigation, it would be prudent for specific attention to be given to the continuous improvement of irrigation practices and the maximisation of the benefits derived.

Priority considerations in respect of water resources management in the Breede water management area include:

- Improvement of irrigation efficiencies.
- The management of salinity levels in the Breede River.
- The improved management of groundwater abstraction. Greater knowledge is needed of aquifer and recharge characteristics, and in particular the interdependencies between groundwater and surface water.
- Additional transfers are likely to be required in future, possibly even within the period under consideration, to serve the greater Cape Town area in the Berg water management area. Although water does not specifically need to be reserved for this purpose at this stage, it would be prudent not to forfeit this option unintentionally by the development of less beneficial projects. Care must therefore be taken that the construction of any new large infrastructure does not prejudice future water transfer options to the Berg water management area.
- No further afforestation should be allowed without the impacts on the ecological component of the Reserve, groundwater recharge and the sensitive salinity balance having been determined and found acceptable.

Water that has to be reserved in the Breede WMA for transfers include the following:

- The transfer of water between the Breede and Berg water management areas via the Riviersonderend/Berg River Scheme. This involves a net transfer of 162 million m³/a to the Berg water management area.
- The transfer of a maximum of 50 million m³/a from the Palmiet River to the Berg water management area. The average transfer is about 22.5 million m³/a.
- Smaller transfers to the Berg water management area amounting to 9 million m³/a.
- The transfer of a maximum of 2.5 million m³/a to the Olifants/Doorn water management area through the Inverdoorn Canal.
- A maximum of 2 million m³/a is reserved in the Gouritz water management area for transfer to the Breede water management area for rural water supply.
- A reservation also applies to the Breede water management area with respect to any new large scale water resource developments which may impact on future transfers to the Berg water management area.

Considering the possible implications of climate change, and indications that its impacts may manifest first in the south-western parts of the country, it is important that the hydrological parameters in the Berg and Breede water management areas are monitored closely. No development or investment decisions should be made that neglect to take into account the actual or potential affects of climatic change on water resources.

D19 WATER MANAGEMENT AREA 19: BERG

D19.1 Introduction

The Berg water management area commands the south-western corner of South Africa. The Berg River is the only major river in the water management area, although there are several smaller rivers and streams draining to the ocean, as shown in Fig. D19. High mountain ranges characterise the east and south-east of the water management area, from where most of the runoff originates, the most well-known being Table Mountain and the Cape Peninsula mountains in the south-west. Sandy lowlands, with minimal runoff, extend across the central and western part of the water management area. Rainfall occurs in winter and is highly varied, ranging from a high of over 3 000 mm/a in the mountains to less than 300 mm/a in the north-west. The Cape Fynbos represents a unique floral kingdom of World Heritage status.

A strong and diversified economy exists in the water management area, which is dominated by industrial and other activities in the Cape Town metropolitan area. However, a close interdependency, particularly with respect to tourism and agriculture, exists with the economic activities of the surrounding area and further inland.

Fig D19: Base map of the Berg water management area



Intensive viticulture and fruit farming, under sophisticated irrigation, are found in the valleys and foothills of the mountains. This changes to extensive rain-fed wheat cultivation in the central regions.

Several large dams and numerous farm dams regulate the surface runoff from the water management area. Regulation will be increased by the addition of the new dam on the Berg River near Franschoek (the Berg Water Project), which has been approved for construction. Significant quantities of groundwater are also abstracted, mainly in the central and western parts of the water management area, with small-scale artificial recharge of groundwater being practised in the vicinity of Atlantis. Large quantities of water are transferred into the area from the Breede water management area via the Riviersonderend/Berg River Scheme and the Palmiet Pumped Storage Scheme (also refer to D18 - Breede water management area). Further potential for the development of water resources exists mainly with respect to the Berg River, although salinity in the lower reaches of the river is becoming a problem, largely as a result of irrigation return flows. Potential may also exist for the abstraction of significant quantities of groundwater from the Table Mountain Group aquifers in the foothills to the east.

Strong economic growth in the Cape Town metropolitan area and vicinity is expected in the foreseeable future. This area is thus likely to form the nucleus for population growth in the water management area.

D19.2 Key statistics relevant to the Berg the water management area

Tables D19.1 to 19.6 contain a breakdown of the information given in Tables 2.1 to 2.6 of Chapter 2 for each sub-area of the Berg water management area. Data is derived primarily from the standardised data base. Different information may be available from other sources.

Table D19.1: Natural mean annual runoff (MAR) and ecological Reserve (million m³/a)

Component/ Sub-area	Natural MAR ¹	Ecological Reserve ^{1,2}
Greater Cape Town	373	61
Upper Berg	849	124
Lower Berg	207	32
Total for WMA	1 429	217

- 1) Quantities are incremental and refer to the sub-area under consideration only.
- 2) The total volume is based on preliminary estimates, with impact on yield being a portion of this.

Table D19.2: Available yield in the year 2000 (million m³/a)

Component/ Sub-area	Natural resource		Usable return flow			Total local yield
	Surface water ¹	Ground-water	Irrigation	Urban	Mining and bulk	
GreaterCape Town	66	20	0	22	0	108
Upper Berg	284	15	8	15	0	322
Lower Berg	30	22	0	0	0	52
Total for WMA	380	57	8	37	0	482

- 1) After allowance for the impacts on yield of the ecological component of the Reserve, river losses, alien vegetation, rain-fed sugar cane and urban runoff.

Table D19.3: Water requirements for the year 2000 (million m³/a)

Sector/ Sub-area	Irrigation	Urban ¹	Rural ¹	Mining and bulk industrial ²	Power generation ³	Afforestation ⁴	Total local requirements
Greater Cape Town	46	343	5	0	0	0	394
Upper Berg	202	23	4	0	0	0	229
Lower Berg	53	23	5	0	0	0	81
Total for WMA	301	389	14	0	0	0	704

- 1) Includes component of Reserve for basic human needs at 25 l/c/d.
- 2) Mining and bulk industrial water uses that are not part of urban systems.
- 3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
- 4) Quantities refer to the impact on yield only.

Table D19.4: Reconciliation of water requirements and availability for the year 2000 (million m³/a)

Component/ Sub-area	Local yield	Transfers in ²	Local requirements	Transfers out ²	Balance ¹
Greater Cape Town	108	269	394	0	(17)
Upper Berg	322	32	229	125	0
Lower Berg	52	18	81	0	(11)
Total for WMA	482	194	704	0	(28)

- 1) Brackets around numbers indicate a negative balance. Surpluses are shown in the most upstream sub-area where they first become available.
- 2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. The addition of the quantities transferred per sub-area does therefore not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables D19.5 and D19.6.

Table D19.5: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Greater Cape Town	111	350	508	0	(47)	27
Upper Berg	405	32	235	206	(4)	100
Lower Berg	52	18	87	0	(17)	0
Total for WMA	568	194	830	0	(68)	127

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes the Berg Water Project and return flows resulting from a growth in requirements.
- 2) Based on a growth in water requirements as a result of population growth and general economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Voëlvlei Dam, and potential diversions from Lourens River and Eerste River.

Table D19.6: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Component/ Sub-area	Local yield ¹	Transfers in	Local requirements ²	Transfers out	Balance ³	Potential for develop- ment ⁴
Greater Cape Town	124	350	913	0	(439)	27
Upper Berg	422	32	270	206	(22)	100
Lower Berg	56	18	123	0	(49)	0
Total for WMA	602	194	1 306	0	(510)	127

- 1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes the Berg Water Project and return flows resulting from a growth in requirements.
- 2) Based on a high growth in water requirements as a result of population growth and the high impact of economic development. Assumes no general increase in irrigation.
- 3) Brackets around numbers indicate a negative balance.
- 4) Based on the raising of the Voëlvlei Dam, and potential diversions from Lourens River and Eerste River.

D19.3 Key elements of the broad strategic perspectives for the Berg water management area

Water requirements in the greater Cape Town sub-area are already well in excess of water availability. Part of the deficits reflected in Table D19.4, however, is attributable to the provision made for the implementation of the ecological component of the Reserve at a later stage. With Cape Town as one of the main growth centres in the country, its strong economic and population growth is projected to continue and this will impact on the future requirements for water. Given the lucrative nature of irrigated agriculture in the water management area, continuous pressure also exists for more water to be made available for irrigation.

Ensuring the sufficient future supply of water to the Cape Town area should be the highest priority for water resource management in the Berg water management area. In an effort to alleviate the situation while implementation planning for the construction of the Berg Water Project is in progress, vigorous initiatives are being taken with regard to water demand management. There will nevertheless be an ongoing need to continue augmenting water resources, and options identified to meet future requirements include the further development of local surface water resources, the exploration of deep groundwater from Table Mountain Group aquifers, increased re-use of urban effluent, additional transfer of water from the Breede River water management area and desalination of sea water.

To facilitate a more accurate assessment of the extent to which local resources may still be developed, priority should be given to determining the ecological component of the Reserve. Until clarity has been gained on the most beneficial use of the remaining resource potential, consideration should be given to imposing a temporary embargo on the construction of new farm dams in the Berg River catchment and on increased pumping from the river. Investigations should also continue to improve knowledge on the potential for utilisation of groundwater from the Table Mountain Group aquifers.

Reservations will apply to the Breede water management area with respect to the transfer of water from the Breede to the Berg water management area. Current transfers are as follows:

- 162 million m³/a from the Rivieronderend catchment.
- 22.5 million m³/a on average from the Palmiet River, with a maximum capacity of 50 million m³/a.
- Smaller transfers from the Breede water management area amounting to 9 million m³/a.

The construction of any large new water infrastructure in the Breede water management area that may impact materially on future water transfers to the Berg water management area will be subject to national approval in order to ensure that options for future water transfers are not inadvertently jeopardized – a reservation in this respect applies to the Breede water management area.

Considering the possible implications of climate change, and indications that its impacts may manifest first in the south-western parts of the country, it is important that the hydrological parameters in the Berg and Breede water management areas are monitored closely. No development or investment decisions should be made that neglect to take into account the actual or potential affects of climatic change on water resources.

Water Management Areas

19 water management areas were established by, and their boundaries defined in Government Notice No. 1160 on 1st October 1999, as follows -

Table E.1: Boundary descriptions of water management areas as Gazetted in October 1999

Water Management Area (Number and Current Name)	Boundary Description
1. Limpopo: Major rivers include the Limpopo, Matlabas, Mokolo, Lephhalala, Mogalakwena, Sand and Nzhelele	Tertiary drainage regions A41, A42, A50, A61 to A63, A71, A72 and A80.
2. Luvuvhu and Letaba: Major rivers include the Mutale, Luvuvhu and Letaba	Tertiary drainage regions A91, A92, B81 to B83 and B90.
3. Crocodile (West) and Marico: Major rivers include the Crocodile (West) and Marico	Tertiary drainage regions A10, A21 to A24, A31, A32 and quaternary drainage region D41A.
4. Olifants: Major rivers include the Elands, Wilge, Steelpoort and Olifants	Tertiary drainage regions B11, B12, B20, B31, B32, B41, B42, B51, B52, B60 and B71 to B73.
5. Inkomati: Major rivers include the Nwanedzi, Sabie, Crocodile (East) and Komati	Primary drainage region X.
6. Usutu to Mhlatuze: Major rivers include the Usutu, Pongola, Mhlatuze, Mfolozi and Mkuze	Primary drainage region W.
7. Thukela: Major river is the Thukela	Primary drainage region V.
8. Upper Vaal: Major rivers include the Wilge, Liebenbergsvlei and Vaal	Tertiary drainage regions C11 to C13, C21 to C23, and C81 to C83.
9. Middle Vaal: Major rivers include the Mooi, Vet and Vaal	Tertiary drainage regions C24, C25, C41 to C43, C60 and C70.
10. Lower Vaal: Major rivers include the Harts, Molopa and Vaal	Tertiary drainage regions C31 to C33, C91, C92 (excluding quaternary catchment C92C), D41 (excluding quaternary catchment D41A), and quaternary catchments D73A and portions of D42C, D42D, D73B, D73C, D73D and D73E. The western boundary of this area runs from the confluence of the Kuruman River with the Molopo River along the watershed between quaternary catchments D42C and D42D until it meets the boundary of the Kalahari East Water Board. The Water Management Area boundary then follows this Water Board boundary to a point, west of the Langberge, 19 kilometres west of Beeshoek, near Postmasburg. The Water Management Area boundary then runs South East to meet the watershed between quaternary catchments D73A and D73B. The boundary then follows this watershed, and that between D73A and D71B, until it meets the watershed of tertiary catchment C92.
11. Mvoti to Umzimkulu: Major rivers include the Mvoti, Umgeni, Umkomazi and Umzimkulu	Primary drainage region U and tertiary drainage regions T40, T51 and T52.
12. Mzimvubu to Keiskamma: Major rivers include the Mzimvubu, Mtata, Mbashe, Buffalo, Nahoon, Groot Kei and Keiskamma	Primary drainage regions R and S, and also tertiary drainage regions T11 to T13, T20, T31 to T36, T60, T70, T80 and T90.
13. Upper Orange: Major rivers include the Modder, Riet, Caledon and Orange	Tertiary drainage regions C51, C52, D11 to D18, D21 to D24, D31, D32, D34 and D35.
14. Lower Orange: Major rivers include the Ongers, Hartbees and Orange	Primary drainage region F (excluding tertiary drainage region F60), tertiary drainage regions D33, D42 (excluding portions of quaternary catchments D42C and D42D), D51 to D58, D61, D62, D71 to D73 (excluding quaternary catchment D73A and portions of D73B, D73C, D73D and D73E), D81, D82, and quaternary catchment C92C.
15. Fish to Tsitsikamma: Major rivers include the Fish, Kowie, Boesmans, Sundays, Gamtoos, Kromme, Tsitsikamma and Groot	Primary drainage regions L, M, N, P, Q and tertiary drainage regions K80 and K90.
16. Gouritz: Major rivers include the Gouritz, Olifants, Kamanassie, Gamka, Buffels, Touws, Goukou and Duiwenhoks	Primary drainage region J and tertiary drainage regions H80, H90, K10 to K70.
17. Olifants/Doorn: Major rivers include the Olifants, Doorn, Krom, Sand, and Sout	Primary drainage region E and tertiary drainage regions G30 and F60.
18. Breede: Major rivers include the Breede, Sonderend, Sout, Bot and Palmiet	Tertiary drainage regions G40 (excluding quaternary catchment G40A), G50, and H10 to H70.
19. Berg: Major rivers include the Berg, Diep and Steenbras	Tertiary drainage regions G10, G21, and G22 and quaternary catchment G40A with the northern boundary following the watershed between tertiary drainage regions G10 and G30 up to the town of Aurora. From Aurora the boundary runs directly to the coast in a westerly direction.

Some minor changes to the water management areas have been proposed to facilitate effective management of water resources - see Part 5 of Chapter 3. The proposed new boundary descriptions are shown in Table E.2. Details of the changes, which are in the Upper Orange, Lower Orange, Lower Vaal and Olifants/Doorn water management areas, are described in Table E.3. The amended boundaries will be established when the NWRS is established.

Table E.2: Revised water management area boundary descriptions

Water Management Area (number and current name)	Boundary Description
1. Limpopo: Major rivers include the Limpopo, Matlabas, Mokolo, Lephakala, Mogalakwena, Sand and Nzhelele	Tertiary drainage regions A41, A42, A50, A61 to A63, A71, A72 and A80.
2. Luvuvhu and Letaba: Major rivers include the Mutale, Luvuvhu and Letaba	Tertiary drainage regions A91, A92, B81 to B83 and B90.
3. Crocodile (West) and Marico: Major rivers include the Crocodile (West) and Marico	Tertiary drainage regions A10, A21 to A24, A31, A32 and quaternary drainage region D41A.
4. Olifants: Major rivers include the Elands, Wilge, Steelpoort and Olifants	Tertiary drainage regions B11, B12, B20, B31, B32, B41, B42, B51, B52, B60 and B71 to B73.
5. Inkomati: Major rivers include the Nwanedzi, Sabie, Crocodile (East) and Komati	Primary drainage region X.
6. Usutu to Mhlatuze: Major rivers include the Usutu, Pongola, Mhlatuze, Mfolozi and Mkuze	Primary drainage region W.
7. Thukela: Major river is the Thukela	Primary drainage region V.
8. Upper Vaal: Major rivers include the Wilge, Liebenbergsvlei and Vaal	Tertiary drainage regions C11 to C13, C21 to C23, and C81 to C83.
9. Middle Vaal: Major rivers include the Mooi, Vet and Vaal	Tertiary drainage regions C24, C25, C41 to C43, C60 and C70.
10. Lower Vaal: Major rivers include the Harts, Molopo and Vaal	Tertiary drainage regions C31 to C33, C91, C92 (excluding the lower portions of quaternary catchments C92B and C92C), D41 (excluding quaternary catchment D41A), and quaternary catchments D73A and portions of D42C, D42D, D73B, D73C, D73D and D73E. The western boundary runs from the border between South Africa and Botswana along the boundary of the Kalahari East Water User Association (WUA). It follows the boundary of the mentioned WUA in a westerly direction to a point, west of the Langberge, 19 kilometres west of Beeshoek, near Postmasburg. The Water Management Area boundary then runs South East to meet the watershed between quaternary catchments D73A and D73B. The boundary then follows this watershed and that between D73A and D71B, until it meets the boundary of the Hay district. It follows this boundary until it meets the watershed between D71B and C92C. The Water Management Area boundary continues along this watershed until it meets the boundary of the Orange Vaal Water User Association. It continues south-easterly on this boundary until it meets the watershed between C92B and C51M where it follows this watershed and that between C92B and C51L. Thereafter it follows the watershed between C51L and C91E. It continues on this watershed until it reaches the farm boundary of Wolwe Dam 87. The Water Management Area boundary then follows the mentioned farm boundary up to the farm boundary of Vaalboschhoek 85. It follows successive farm boundaries as they meet, progressively moving in a westerly direction, namely: Weltevrede 117, Vaalpan 118, Koppiesdam 119, Spiji Fontein 122, Kareebosch 130, Osfontein 121, Benaauwheidsfontein 442, Olifantskop 196, Sussana 197, and Olifantsdam 170. The Water Management Area boundary then follows the eastern boundary of Olifantsdam 170 in a northerly direction to include the farm Olifantsrug 293 until it meets the watershed between C91E and C52L. Hereafter, the Water Management Area boundary follows the boundaries of the drainage regions as mentioned initially in this description.
11. Mvoti to Umzimkulu: Major rivers include the Mvoti, Umgeni, Umkomazi and Umzimkulu	Primary drainage region U and tertiary drainage regions T40, T51 and T52.
12. Mzimvubu to Keiskamma: Major rivers include the Mzimvubu, Mtata, Mbashe, Buffalo, Nahoon, Groot Kei and Keiskamma	Primary drainage regions R and S, and also tertiary drainage regions T11 to T13, T20, T31 to T36, T60, T70, T80 and T90.
13. Upper Orange: Major rivers include the Modder, Riet, Caledon and Orange	Tertiary drainage regions C51, C52, D11 to D18, D21 to D24, D31, D32, D33 (noting that the lower portion of quaternary catchment D33K is excluded where the Water Management Area boundary follows the boundary of the Orange Vaal WUA), D34 and D35.

Table E.2 continued: Revised water management area boundary descriptions

Water Management Area (number and current name)	Boundary Description
14. Lower Orange: Major rivers include the Ongers, Hartbees and Orange	Primary drainage region F (excluding quaternary catchments F50D, F60B, F60C, F60D and F60E), tertiary drainage region D42 (excluding portions of quaternary catchments D42C and D42D), D51 to D58, D61, D62, D71 to D73 (excluding quaternary catchment D73A and portions of D73B, D73C, D73D and D73E), D81, D82. In the area of the confluence of the Vaal and Orange Rivers the Water Management Area boundary follows the boundary of the Orange Vaal Water User Association until it meets the boundary of Water Management Area 10. Hence, the lower portions of quaternary catchments C92B and C92C are included in this Water Management Area.
15. Fish to Tsitsikamma: Major rivers include the Fish, Kowie, Boesmans, Sundays, Gamtoos, Kromme, Tsitsikamma and Groot	Primary drainage regions L, M, N, P, Q and tertiary drainage regions K80 and K90.
16. Gouritz: Major rivers include the Gouritz, Olifants, Kamanassie, Gamka, Buffels, Touws, Goukou and Duiwenhoks	Primary drainage region J and tertiary drainage regions H80, H90, K10 to K70.
17. Olifants/Doorn: Major rivers include the Olifants, Doorn, Krom, Sand, and Sout	Primary drainage region E and tertiary drainage regions G30 and F60 (excluding quaternary catchment F60A) and quaternary catchment F50D.
18. Breede: Major rivers include the Breede, Sonderend, Sout, Bot and Palmiet	Tertiary drainage regions G40 (excluding quaternary catchment G40A), G50, and H10 to H70.
19. Berg: Major rivers include the Berg, Diep and Steenbras	Tertiary drainage regions G10, G21, and G22 and quaternary catchment G40A with the northern boundary following the watershed between tertiary drainage regions G10 and G30 up to the town of Aurora. From Aurora the boundary runs directly to the coast in a westerly direction.

Table E.3: Details of amendments to water management area boundaries

Water Management Area Boundary	Proposed Boundary Amendment
Lower Orange and Olifants /Doorn	Quaternary catchment F50D is moved from Lower Orange to Olifants/Doorn, and F60A is moved from Olifants/Doorn to Lower Orange.
Lower Orange and Upper Orange	Tertiary catchment D33 moves from the Lower Orange to the Upper Orange.
Lower Orange and Lower Vaal	The boundary of the Lower Orange moves to incorporate the entire area of the Orange Vaal Water User Association.
Lower Orange and Lower Vaal	Following from the Orange Vaal Water User Association boundary, the large part of quaternary catchment C92C moves into the Lower Vaal. The boundary follows the Water User Association boundary, the quaternary catchment boundary and the Vaal Gamagara supply boundary.
Lower Orange and Lower Vaal	The boundary follows the Kalahari East Water User Association boundary until it meets with the northern border of South Africa with Botswana, and then follows this border west.
Lower Vaal and Upper Orange	The boundary follows a combination of drainage region boundaries, the boundaries of groundwater aquifers and farm boundaries.

Note: The boundary changes described above were made after the balances between water availability and water requirements for water management areas and sub-divisions of water management areas, described in Chapter 2 and Appendix D, were calculated. The boundary changes have insignificant impact on the statistics presented, and any discrepancies will be corrected at the first revision of the NWRS.

Public Consultation

The requirement for public consultation on the Proposed National Water Resource Strategy (Proposed NWRS) is described in section 5 of the National Water Act (see Appendix C). This appendix provides key details of the consultation process adopted by the Department.

Pre-publication: March - August 2002

- 120 000 A4 Z-fold information leaflets about the Proposed NWRS were distributed during Water Week in March 2002.
- A national stakeholder database was compiled, comprising about 8 400 organisations and individuals.
- Letters were distributed to all stakeholders on the database announcing the impending availability of the Proposed NWRS, inviting them to participate in the consultation process, and including a four page briefing document.
- Letters were sent to all stakeholders informing them of the dates and venues of regional public meetings and national workshops and inviting them to attend.
- Advertisements announcing the public meetings were published in four national newspapers and in at least one local newspaper in each water management area.

Publication: August 2002

- A 59 page Summary of the Proposed NWRS was published in the Government Gazette.
- Hard copies of the Summary, the full text of the Proposed NWRS (approximately 250 pages) and a 16 page Information Document (the latter in all 11 official languages) were made available for inspection at the public places, including the offices of the Department of Water Affairs and Forestry, listed in Table F.1.

Public meetings and national workshops: mid-September - April 2003

- A series of 24 public meetings was held at venues throughout the country, together with five national workshops in the Pretoria/Johannesburg area (see Table F.2). The meetings and workshops included presentations on the contents of the Proposed NWRS followed by facilitated discussions, and were attended by a total of more than 2 000 people.
- All comments at the meetings and workshops were recorded, and written comments were invited.
- In addition during the consultation process -
 - The Parliamentary Portfolio Committee on Water Affairs and Forestry was briefed on the Proposed NWRS in October 2003.
 - The consultation process was announced on national television (50-50) and in approximately 20 radio interviews.
 - Ten capacity building workshops for departmental staff were held to prepare them for the public meetings.
- After the nationally-organised series of meetings was concluded -
 - More than 40 additional public meetings were held by the Regional offices on request by stakeholders.
 - Workshops/briefing sessions were held with the Chemical and Allied Industries Association (Johannesburg), the South African Water Caucus (Johannesburg, Cape Town and Durban) and the Water Institute of Southern Africa Mining Division (West Rand).
 - Almost 18 500 copies of documents directly related to the Proposed NWRS - full and Summary documents, information documents and copies of slides presented at the public meetings - were distributed on request from stakeholders, together with 860 copies of other departmental documents.

Review of comments

- By May 2003 a total of more than 2 300 comments had been received on individual chapters and parts from more than 600 commentators.
- All comments were reviewed by a team of departmental officials, and amendments to the proposed NWRS proposed and submitted to senior staff members. The opportunity was also taken to update information in the Proposed NWRS to reflect developments since its publication, and to undertake a plain language edit.
- The amended NWRS, First Edition was then reviewed by an external reviewer and by the Minister's office, and necessary changes made.

Table F.1: Availability of NWRS documentation at public places**EASTERN CAPE**

DWAF Area Office: Cradock
 DWAF Area Office: East London
 DWAF Regional Office: King Williams Town
 DWAF Area Office: Port Elizabeth
 DWAF Area Office: Umtata
 Grahamstown Public Library

FREE STATE

City Library: Bloemfontein
 DWAF Regional Office: Bloemfontein
 Welkom Public Library

GAUTENG

Carletonville Library
 DWAF Head Office: Pretoria
 DWAF Regional Office: Pretoria
 DWAF Area Office: Potchefstroom
 Germiston Library
 Johannesburg Library
 Soweto Library

KWAZULU-NATAL

Dundee Public Library
 DWAF Regional Office: Durban
 Empangeni Public Library
 Natal Society Library in Pietermaritzburg
 Newcastle Public Library
 Richards Bay Public Library

LIMPOPO

DWAF Regional Office: Polokwane
 Louis Trichardt Public Library
 Mussina Public Library
 Phalaborwa Public Library
 Thohoyandou Public Library
 Tzaneen Public Library

MPUMALANGA

AWARD NGO Office (Acornhoek)
 Barberton Public Library
 DWAF Area Office: Groblersdal

MPUMALANGA (continued)

DWAF Regional Office: Nelspruit
 DWAF Offices: Tonga, Malekutu, Eerstehoek
 Mvula NGO Office (Nelspruit)
 Groblersdal Public Library
 Mzinti Agricultural Centre
 Nelspruit Public Library
 Secunda Public Library
 Witbank Public Library

NORTHERN CAPE

Calvinia Hantam Municipality Offices
 De Aar Emthanjeni Municipality Offices
 DWAF Regional Office: Kimberley
 DWAF Area Office: Upington
 Namaqua District Municipality Offices
 Northern Cape Agricultural Union, Upington
 Prieska Public Library
 Springbok Public Library

NORTH-WEST

DWAF Area Office: Hartbeespoort Dam
 DWAF Regional Office: Mmabatho
 Groot Marico Public Library
 Klerksdorp Public Library
 Lichtenburg Public Library
 Rustenburg Public Library
 Vryburg Public Library

WESTERN CAPE

Beaufort West Public Library
 DWAF Regional Office: Bellville
 DWAF Area Office: Clanwilliam
 Caledon Public Library
 George Public Library
 Hermanus Public Library
 Lambertsbaai Public Library
 Library of Parliament in Cape Town
 Oudtshoorn Public Library
 Witzenberg Municipality

Table F.2: National (key stakeholder) workshops and regional public meetings

National (key stakeholder) workshops			
Sector	Place	Date	Attendance
National Government departments	Pretoria	16th September 2002	43
Agriculture	Pretoria	26th September 2002	32
Forestry	Pietermaritzburg	18th October 2002	12
Water and waste management	Pretoria	4th November 2002	77
Industry, mining and power generation	Midrand	11th November 2002	63
Regional public meetings			
Water Management Area	Place	Date	
3 Crocodile (West) & Marico	Midrand	17th September 2002	85
	Rustenburg	18th September 2002	82
8 Upper Vaal	Vereeniging	19th September 2002	112
	Carletonville	20th September 2002	69
12 Mzimvubu to Keiskamma	East London	26th September 2002	69
	Umtata	27th September 2002	40
4 Olifants	Witbank	1st October 2002	78
19 Berg	Stellenbosch	2nd October 2002	92
5 Inkomati	Nelspruit	3rd October 2002	108
18 Breede	Worcester	3rd October 2002	76
9 Middle Vaal	Welkom	8th October 2002	73
13 Upper Orange	Bloemfontein	19th October 2002	86
11 Mvoti to Umzimkulu	Pietermaritzburg	15th October 2002	109
7 Thukela	Ladysmith	16th October 2002	82
15 Fish to Tsitsikamma	Port Elizabeth	22nd October 2002	62
16 Gouritz	Oudtshoorn	24th October 2002	86
1 Limpopo	Polokwane	29th October 2002	59
2 Luvuvhu & Letaba	Thohoyandou	30th October 2002	46
10 Lower Vaal	Kimberley	29th October 2002	96
14 Lower Orange	Upington	31st October 2002	69
	Springbok	7th November 2002	57
17 Olifants-Doorn	Clanwilliam	13th November 2002	68
6 Usutu to Mhlathuze	Richard's Bay	19th November 2002	74
	Vryheid	20th November 2002	53

Document List

A very large number of documents was consulted in compiling the NWRS. In general only the primary, departmentally-approved reference to a particular topic is listed here, and this will lead the reader on to subsidiary, more detailed documents. As additional documents are developed and finalised they will be placed on the Department's Internet site - <http://www.dwaf.gov.za>.

• Policy

Water Supply and Sanitation Policy, White Paper, Department of Water Affairs and Forestry. November 1994

White Paper on a National Water Policy for South Africa, Department of Water Affairs and Forestry, April 1997.

White Paper on Disaster Management, Ministry for Provincial Affairs and Constitutional Development, January 1999.

Strategic Framework for Water Services, Department of Water Affairs and Forestry, September 2003.

• Legislation

Constitution of the Republic of South Africa (No. 108 of 1996).

Water Services Act (No. 108 of 1997).

National Water Act (No. 36 of 1998).

Environmental Conservation Act (No. 73 of 1989)

National Environmental Management Act (No. 107 of 1998).

Public Finance Management Act (No. 29 of 1999).

Promotion of Administrative Justice Act (No. 2 of 2000).

Promotion of Access to Information Act (No. 3 of 2000).

National Disaster Management Act (No. 57 of 2002).

• Water Resources Planning

Overview of Water Resources Availability and Utilisation in South Africa, BKS Inc for DWAF, Report P RSA/00/0197 May 1997, ISBN 0 7970 3540 0

Reports on Water Resources Situation Assessment Studies

- WMA 1 Limpopo: Main Report No. 01000/00/0301, DWAF, August 2001.
- WMA 2 Luvuvhu and Letaba: Main Report No. 02000/00/0301, DWAF, August 2001.
- WMA 3 Crocodile West and Marico: Main Report No. 03000/00/0301, DWAF, August 2001.
- WMA 4 Olifants: Main Report No. 04000/00/0301, DWAF, August 2001.
- WMA 5 Inkomati: Main Report No. 05000/00/0301, DWAF, August 2001.
- WMA 6 Usutu to Mhlatuze: Main Report No. 06000/00/0301, DWAF, August 2001.
- WMA 7 Thukela: Main Report No. 07000/00/0301, DWAF, August 2001.
- WMA 8 Upper Vaal: Main Report No. 08000/00/0301, DWAF, August 2001.
- WMA 9 Middle Vaal: Main Report No. 09000/00/0301, DWAF, August 2001.
- WMA 10 Lower Vaal: Main Report No. 10000/00/0301, DWAF, August 2001.
- WMA 11 Mvoti and Umzimkulu: Main Report No. 11000/00/0301, DWAF, August 2001
- WMA 12 Mzimvubu to Keiskamma: Main Report No. 12000/00/0301, DWAF, August 2001
- WMA 13 Upper Orange: Main Report No. 13000/00/0301, DWAF, August 2001.
- WMA 14 Lower Orange: Main Report No. 14000/00/0301, DWAF, August 2001.
- WMA 15 Fish to Tsitsikamma: Main Report No. 15000/00/0301, DWAF, August 2001.
- WMA 16 Gouritz: Main Report No. 16000/00/0301, DWAF, August 2001.
- WMA 17 Olifants/Doring: Main Report No. 17000/00/0301, DWAF, August 2001.
- WMA 18 Breede: Main Report No. 18000/00/0301, DWAF, August 2001.
- WMA 19 Berg: Main Report No. 19000/00/0301, DWAF, August 2001.

The Distribution of South Africa's Population, Economy and Water Usage into the Long Term Future, L Schlemmer and Markdata (Pty) Ltd for DWAF, 2001.

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