Water for Growth & Development Framework

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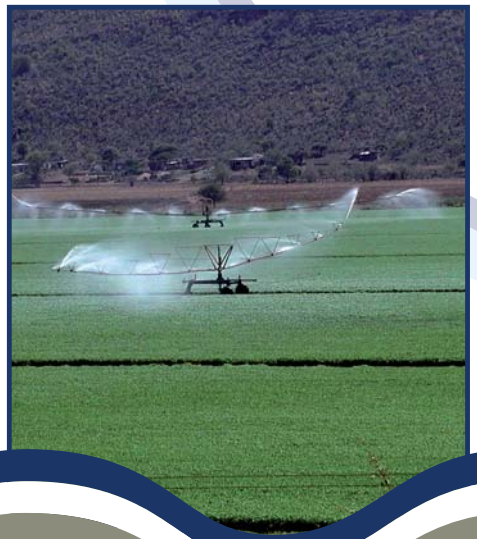


water & forestry

Department:
Water Affairs & Forestry
REPUBLIC OF SOUTH AFRICA

1 Foreword

I am pleased to present the Water for Growth and Development Framework, which represents our commitment to water security for the people, the economy and the environment for now and in the future.

This framework is the result of two years' worth of consultations with key players in the water sector and we thank everyone that has played a role in its development to date. In January 2009, Cabinet gave us approval to engage in an extensive consultation process with all stakeholders involved in the water sector. The process of developing the framework has forced the Department to confront some hard truths about challenges in the sector and what needs to be done to address these. In the last couple of months, there has been widespread debate on the status of water in South Africa. This framework presents a comprehensive response to the challenges facing us whilst simultaneously responding proactively to the needs of our economy. We must proactively and collectively develop our own solutions, based on our understanding of these challenges and opportunities presented to us, bearing in mind that water is a scarce resource and we need to look after it wisely.

The framework will set the foundation and create the necessary pointers for the development of the National Water Resources Strategy, which is a legislative requirement, and it must be seen as setting the framework for the development of this strategy.

South Africa is a dry country with limited water resources, which requires careful management so that we are able to extend basic water services to every citizen whilst meeting the needs of economic growth without threatening the environmental integrity of water resources. Government is constantly balancing the escalating and competing demands on the country's limited water resources, ever mindful of the fact that water for social development and economic growth and environmental sustainability are equally important for the success of this country.

We take pride in our successes to date, which include the development of outstanding policy and legislation, the delivery of water and sanitation services to millions of previously un-serviced households, and the ongoing expansion and upgrading of the extensive network of water resources infrastructure. However, this is no time to be complacent as the escalating demands on reliable and high quality water test our mettle.

A different mindset is required to embrace the changes needed to ensure water availability and water quality management. Due to technological advances and increasing affordability, we are now able to contemplate innovative water sources such as water desalination and treated effluent for various uses, preserving our high quality water for consumptive use only. In the framework, we refer to this as 'diversifying the water mix' and it represents a break from the traditional way of ensuring water supply and a step into the realm of multiple water sources, where quantity and quality are aligned to need. It is a bold but necessary step moving forward.

I also know that too often South Africans use water in the most inefficient way and we are committed to facilitating major behavioural changes in this regard. We have established that the most cost-effective way of ensuring water availability is ultimately through water conservation and water demand management, and resources will be channelled accordingly. This requires that we pledge our full commitment to conserving water and spare no effort in doing so whether it be in our households, in our schools, industry, manufacturing, etc to save water as 'every drop counts'.

The importance of joint planning and co-ordinated implementation also cannot be overemphasised. Government, in concert with other water management institutions, needs to work collectively and swiftly so that we achieve the common goal of ensuring water security across generations. We realise that this department cannot achieve the objectives of the framework alone. The water sector is a highly dynamic and complex environment, akin to an orchestra and as the conductor, I hope to lead the sector to new heights. The consultation process will seek to garner the support that my department needs from all the sectors and the general public in order for the framework to achieve its objectives.

Your commitment, inputs and contributions are important to us and we will endeavour to reflect and incorporate your views during our consultations. I would like to thank you in anticipation for your support.

MRS L B HENDRICKS MP
MINISTER OF WATER AFFAIRS AND FORESTRY

2 Executive Summary

The Department of Water Affairs and Forestry (DWAF) is developing a framework to guide actions and decisions that will ensure water security in terms of quantity and of quality to support South Africa's requirements for economic growth and social development. Sufficient supply of water is a requirement for the country to achieve its economic growth targets. The provision of potable water to every person in South Africa is also a fundamental developmental goal that needs to be facilitated by the department's framework. These two goals must be achieved without compromising the ecological sustainability of water resources.

The Department has also embarked upon rigorous water assessment studies referred to as Reconciliation Strategies in order to reconcile the supply and demand for water, particularly in water scarce areas and areas experiencing relatively high levels of demand. These strategies aim to ensure the supply of water at adequate levels of assurance within the constraints of affordability, appropriate levels of service to users, and the protection of current and possible future water resources. Thus far, six studies have been undertaken in the major urban centres and in July 2008, the Department commissioned reconciliation strategies for every town in the country, due to be completed by 2011.

Water scarcity has been identified in the major urban centres. These major urban areas anchor the country's economy, and the Department has to invest heavily in the diversification of its water mix in order to prevent serious water shortages from adversely impacting on our economy. In addition to the traditional augmentation schemes, two major ways that water supplies can be augmented are the treatment of effluent and the desalination of sea water for productive use. A key principle behind assuring local water supplies is to limit the expense of transporting water by keeping supplies as close to the end-user as possible.

The Department also appreciates that whilst investments have been made in water schemes to assure water supply, there is a need to strengthen its focus on water conservation and water demand management, especially since a very basic cost analysis shows a better return on investment from water loss control and water use efficiency measures than from additional supply-side interventions. A major source of water loss is ageing infrastructure exacerbated by poor operations and maintenance at a municipal level. Analysis shows that this state of affairs is a multi-faceted problem including a lack of managerial and technical skills, and a lack of funding. The Department will strengthen its regulatory efforts to support this sector in a bid to reverse this dire situation; it becomes an even more crucial intervention when the pollution of water resources is due to faulty wastewater treatment works.

The phrase "water for development" refers to the critical role of water in poverty alleviation and people's constitutional right to have reliable access to safe drinking water. The Department is deeply concerned about the persistent backlogs in certain parts of the country. By 2005, it had already achieved the Millennium Development Goal of halving, "by the year 2015 the proportion of people who are unable to reach or to afford safe drinking water".

The Department is also very aware of anomalies in water distribution, such as communities that reside next to water sources but do not access to these. The Department remains committed to ensuring that every person has access to a safe and reliable supply of drinking water hence the framework for growth and development.

In terms of service backlogs, it is the Department's recommendation that resolving these backlogs is prioritised and addressed through a combination of short- and long-term interventions. Such interventions would include rainwater harvesting, the development and treatment of groundwater sources, and exploring the possibility of extending the reach of existing water supplies to additional communities.

A balance is needed between bulk and small-scale infrastructure projects. Where a community can be serviced by existing large-scale infrastructure, this should happen with immediate effect. Where a community cannot be serviced by bulk infrastructure projects due to the cost of such an intervention (for example, pumping water to mountain-top communities at higher altitudes), then localised schemes must be planned and implemented. Where large-scale infrastructure could solve local water scarcity, such as the De Hoop Dam, the necessary planning and resourcing must be undertaken and interim measures introduced to compensate for the long lead-times. The Department will also prioritise schemes in areas with resource development potential but with high service backlogs. It will also support sector plans where water use for

economic growth purposes can also support social development needs. The Department will particularly seek for and support interventions in the water sector that explicitly provide for the dual goals of growth and development, since one goal should not be realised at the expense of the other.

The Water for Growth and Development Framework points to the relationship between water availability and the many forms of economic activity that depend on available water supply of specific levels of quality. The Department's position is that the country's economic growth target cannot be achieved at the expense of the ecological sustainability of water resources or meeting people's human needs. It wishes to respond to the needs of the different economic sectors and this is best achieved when water supply and the impact of use are factored in during planning. Rather than being an add-on or afterthought, the Department sees the need for water to be mainstreamed and placed at the nucleus of all planning decisions both in the public and private sector. For water to support economic growth without compromising primary needs or ecological sustainability requires adequate planning at a strategic level and in an integrated manner.

The Department is very mindful of water use behaviour that impacts negatively on water resource quantity and quality. It is currently exploring a potential mix of mechanisms to change this behaviour that includes regulatory instruments, market-based instruments, self-regulation, and awareness and education. The Department plans to match mechanisms to offending behaviour in ways that appropriately mitigate its effects.

The Department is taking action to ensure it has reliable information to better support cross-sectoral planning and development initiatives in its decisions and trade-offs. The rolling out of the Reconciliation Strategies to various parts of the country will ensure that the Department is able to anticipate and address future demand without any one aspect of water need (social, economic, or ecological) being compromised.

2.1 High level recommendations

2.1.1 Strengthening institutional capacity

While the Reconciliation Strategies identify potential water imbalances and interventions to be taken to avert water shortages, if the Department lacks the capacity to oversee the implementation of these strategies and other aspects of its mandate, the consequence may be water shortages that result from poor management rather than a true deficiency of supply.

The Department has embarked on a process of institutional re-alignment to ensure that the Catchment Management Agencies and, in their absence, the DWAF Regional Offices, are able to fulfil the role of implementing agents tasked with an array of water resource management functions.

2.1.2 Mainstreaming water

It is the Department's intention to ensure that water is placed at the heart of all planning decisions taking place in the country; to ensure that any decisions taken that rely on the steady supply of water, both in quantitative and qualitative terms, adequately factor in water availability. Water can only support growth and development in the country without compromising the ecological sustainability of the resource if, and only if, water is at the nucleus of planning and decision-making, which includes but is not limited to sectoral planning. In an effort to elevate the status of water in terms of it's value-add for growth and development, and accentuating the fact that this is a scarce and vulnerable resource, the Department acknowledges the importance of strengthening its regulatory role, providing support and guidance to the plethora of stakeholders, affecting and influencing the sector.

2.1.3 Diversifying the water mix

Water availability is currently based on surface water (77%), return flows (14%) and groundwater (9%). Reconciliation studies undertaken in major urban centres have revealed that in addition to these sources, desalination and effluent re-use ought to be considered given the high risk of water shortages. Desalination refers to the treatment of saltwater and effluent re-use refers to the treatment of urban and mining effluent. Both are a major source of water for coastal cities and treated effluent for major inland systems. In the long term, surface water will remain the predominant source of water but the Department expects a reduction on the dependence on this source accompanied by the increased use of groundwater and a significant increase in return flows through the treatment of urban and mining effluent. The mix at the local level will be dependent on the most affordable and appropriate source depending on water use; for

example, desalination of seawater for productive uses in coastal locations is considered highly feasible provided that it is not transported inland – similarly, inland water resources should be retained for use inland.

2.1.4 Promoting Water Conservation and Water Demand Management

The reality is that as a country, we can no longer afford water losses and therefore it is imperative that the focus on water conservation and water demand management must be strengthened, especially as there is a greater return on investment through water loss control and water use efficiency. The Department will prioritise the establishment of the water demand funding facilitation unit to provide support to municipalities in their effort to introduce water conservation and demand management.

2.1.5 Promoting and maintaining water quality

The Department is extremely concerned about the status of the quality of the country's water resources. It has undertaken to strengthen its compliance enforcement and monitoring as a way of clamping down on water use behaviours that have a detrimental impact on our water resources. It has also identified that a key challenge to sustained and healthy water supplies is the poor maintenance of waste water treatment works (WWTW) and the Department will work closely with the Department of Provincial and Local Government (DPLG) to restructure the Municipal Infrastructure Grant (MIG) so that it is used for the purposes of WWTW rehabilitation and construction. Lastly, the Department wishes to see rapid and effective action taken to address the threat that acid mine drainage poses to the immediate and long-term integrity of our water quality.

2.1.6 Water for Development: Addressing service backlogs

The Department has reached the Millennium Development Goals (MDGs) targets in respect to the halving of water and sanitation backlogs in 2005 and 2008 respectively. However, too many South Africans still do not have access to basic water and sanitation services and the Department therefore wishes to achieve the target of full access to basic water and sanitation services for all by 2014. It is the Department's recommendation that the service backlogs are prioritised and addressed through a combination of short-term interventions such as rainwater harvesting and the further enhancement of groundwater sources. Ultimately, a balance needs to be struck between large and small-scale infrastructure projects. Where a community can be serviced by existing large-scale infrastructure, this should happen with immediate effect. Where a community cannot be serviced by a large-scale infrastructure project due to the cost of such an intervention (for example, pumping water to mountain-top communities at higher altitudes), then small-scale schemes must be planned and implemented. Where large-scale infrastructure could solve local water scarcity, such as the De Hoop Dam, the necessary planning and resourcing must be undertaken and interim measures introduced to compensate for the long lead-times. The Department should also prioritise schemes in areas with resource development potential that coincide with areas with high service backlogs. It will also support sector plans where water use for growth purposes can simultaneously support water use for development purposes. The Department will seek out and support interventions that support the dual goals of water for growth and development, as one goal should not be prioritised at the expense of the other.

2.1.7 Water for Growth: Changing water use behaviour for the future

The Department is very mindful of water use behaviour that impacts negatively on the resource both quantitatively and qualitatively. It is currently exploring a potential mix of mechanisms to change this behaviour, which include regulatory instruments, market-based instruments, self-regulation, and awareness and education, and it will match appropriate mechanisms to mitigate offending behaviour. Currently, there are two sets of behaviours that it is very concerned about and which it wishes to address as a matter of urgency. The first is the unlawful and damaging extraction from, and pollution of the Vaal River system by commercial users. The second is the extent of water use inefficiencies among commercial irrigation agriculture.

Commercial irrigation agriculture receives 62% of allocated water and to date has been exempted from certain water charges. It is the Department's view that this sector needs to make a contribution to the operations and maintenance of state-owned irrigation infrastructure as particular consumptive behaviours in the sector suggest that water may be too cheaply priced. The Department is also considering other interventions including water allocation reform, water trading and the promotion of techniques to enhance water use efficiency by this sector.

2.1.8 Nurturing attitudinal and behavioural changes towards the value of water

The Department over the years has invested significantly in water awareness campaigns and intends to sustain these campaigns, especially targeting younger children of primary school age. The Department's philosophy is that meaningful change in people's attitudes towards water must be inculcated from a young age in order to reap the benefits of these positive attitudes in the future. However, these campaigns should not be targeted at the younger generations only and for this reason it anticipates the conceptualisation and launching of a massive national awareness campaign whose primary purpose will be to instil a sense of appreciation of the value of water among all South Africans. The impact of the campaign should be a change in attitude and behaviour towards water conservation and water use efficiency resulting in the realisation of the WfGD's vision of 'water is life – securing our needs across generations' underpinned by the principle of 'every drop counts'.

Table of Contents

ACRONYMS

AMD	Acid Mine Drainage
ASGISA	Accelerated and Shared Growth Initiative for South Africa
CME	Compliance, Monitoring and Enforcement
DEAT	Department of Environmental Affairs and Tourism
DoA	Department of Agriculture
DPLG	Department of Provincial and Local Government
DWAF	Department of Water Affairs and Forestry
EPWP	Extended Public Works Programme
IAM	Infrastructure Asset Management
ISP	Internal Strategic Perspective
MDG	Millennium Development Goal
MIG	Municipal Infrastructure Grant
MTEF	Medium Term Expenditure Framework
NSDP	National Spatial Development Perspective
NWA	National Water Act
NWRIA	National Water Resource Infrastructure Agency
NWRS	National Water Resource Strategy
ROA	Return of Asset
RQO	Resource Quality Objectives
SFRA	Stream Flow Reduction Activity
SFWS	Strategic Framework for Water Services
WAR	Water Allocation Reform
WC/WDM	Water Conservation and Water Demand Management
WDCS	Waste Discharge Charge System
WfGD	Water for Growth and Development
WfW	Working for Water
WMA	Water Management Area
WSA	Water Services Authority
WSI	Water Services Institution
WSSCU	Water Sector Support Co-ordination Unit
WWTW	Waste Water Treatment Work

3 Introduction

The Department of Water Affairs and Forestry (DWAF) has undertaken the preparation of the Water for Growth and Development (WfGD) Framework to ensure that water is able to support both the economic growth and development goals of South Africa.

It is acknowledged that as valuable resource, water is both a social and economic good supporting all facets of human life. This is encapsulated in the WfGD vision: "Water is life – Securing the Nation's Needs Across Generations".

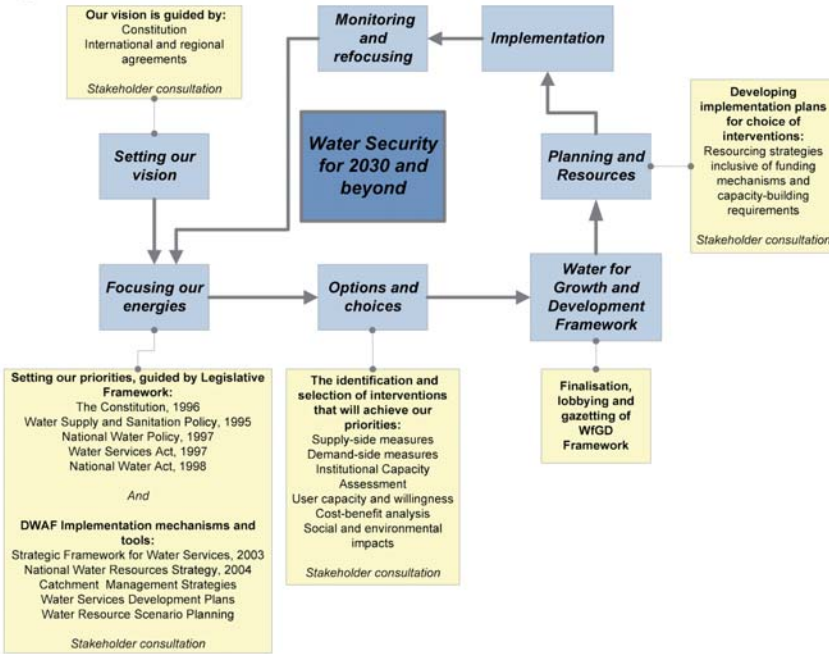
The WfGD represents an acknowledgement that water has a multiplicity of roles including:

- Supporting the economic activities that will be required to achieve the economic growth targets Wof South Africa
- Providing for domestic and social needs
- Maintaining the environment
- Improving the overall quality of life of people living in South Africa

WfGD seeks to strike an appropriate balance between supply and demand driven approaches, taking into account the specific constraints pertaining to this resource. Its intention is to place water at the heart of all planning that takes place in the country so that any decisions that rely on the steady supply of water adequately factor in water availability. It seeks to ensure that there is sustained investment in the water sector to avert any potential water crises and to ensure that water management supports social and economic growth targets government envisions for South Africa without compromising ecological sustainability of the resource.

The process for developing the framework is depicted in the following graph:

Figure 1 WfGD Architecture



The purpose of this document, being in the formative stages of the WfGD life cycle, is to identify trends in water-intensive sectors and the economic value of water in these sectors. It will also identify some of the key challenges, threats and risks to water security and present current and possible future interventions to address these challenges.

4 The context

The central question that is being asked is: Does South Africa have sufficient water resources to sustain both its path of economic growth and its population growth and concomitant needs? In addressing this question, the Department has taken a long term perspective and is assessing and addressing in a very detailed manner the quantity of water available in relation to projected demand, and ways of addressing imbalances where they exist. This is taking the form of reconciliation strategies, which have been completed for some of the country's major water supply systems, and are to be followed by reconciliation studies for every town in South Africa. By mid-2011, the Department will have an accurate picture of water demand and supply and how to achieve the required balance at a micro level.

This framework therefore seeks to look at water supply and demand from a global perspective as well as to identify some of the key pressures being placed on the resource.

4.1 A National perspective of water availability

The following figure presents the water balance in 2000 and shows that a quarter (five) of the Water Management Areas (WMA) experience water shortages, a further quarter have water surpluses, and the remainder are in balance.

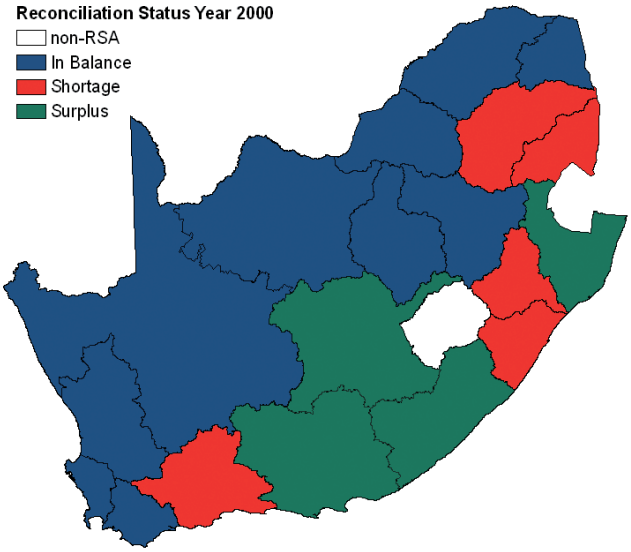


Figure 2: Water demand/supply scenarios 2000

The second figure, which is a supply/demand scenario for 2025, illustrates that shortages will become more prevalent if proper attention is not given to providing more water, and managing demand. In general, the country is more likely to experience water shortages than surpluses.

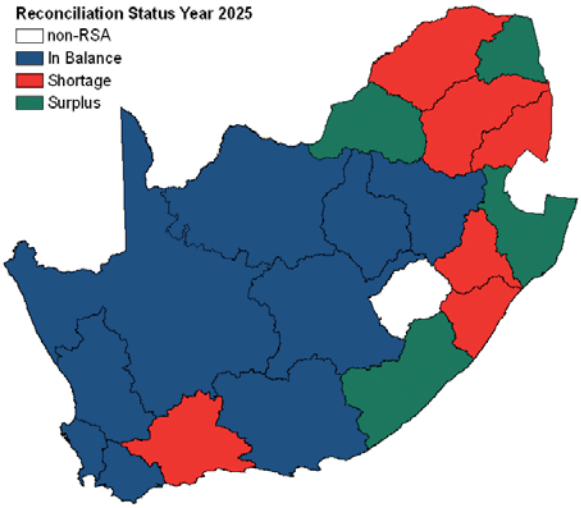


Figure 3: Water demand/supply scenarios 2025

If reconciliation strategies are developed and implemented i.e. if we all do our work, the country's demand and supply could be in balance (Figure 4). This is what we must strive for.

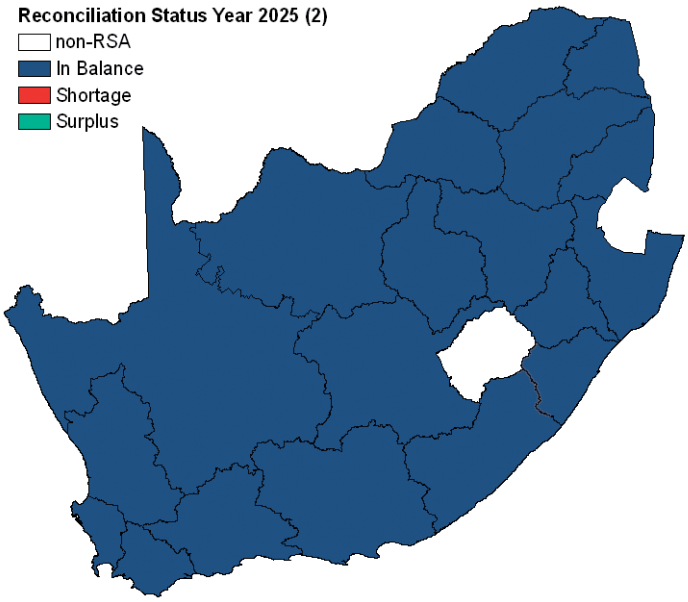


Figure 4: Water demand/supply scenarios 2025

These maps highlight the positive impact that infrastructure investment has had on the security of water supply as witnessed through the construction of the Nandoni dam in the Luvubu/Letaba WMA. It also highlights the facts that the four major metropolitan areas need serious consideration, especially in light of the rapid rate of urbanisation.

It is the Department's view that sufficient water supplies can be made available to all significant urban and industrial growth points to support economic growth. However, given the long lead times for developing new water schemes, co-operative planning between water users and water management must be enhanced to ensure that the demands can be met.

4.2 Transboundary agreements

South Africa has entered into a number of bi- and tri-lateral transboundary water agreements with neighbouring Southern African Development Community (SADC) states in relation to shared watercourses such as the Orange and Limpopo River systems. An overarching agreement is the South African Development Community Revised Protocol on Shared Watercourses, signed in 2000. It provides a framework for future water resource development and management in the shared watercourses in SADC. It promotes and facilitates the establishment of shared watercourse agreements and institutions to manage these agreements.

Prior to the signing of this agreement, water agreements between South African and its neighbours stretch back many years, including the signing of the agreement between South Africa and the Republic of Portugal "in regard to rivers of mutual interest and the Cunene River Scheme" in 1964. South Africa has established Bilateral Water Commissions with Namibia (1992), Botswana (date unknown), and Mozambique (1994). In 1986, South Africa signed the Treaty on the Lesotho Highlands Water Project with Lesotho leading to establishment of the Lesotho Highlands Water Commission to implement the scheme. Furthermore, an agreement was signed between South Africa and Botswana in 2007 to enable water supply authorities and water service providers to enter into contractual arrangements to supply water across the borders.

Several multilateral Water Commissions have been established to implement particular projects or to enhance joint management of shared watercourses. In 2000, an agreement was signed with the governments of Botswana, Lesotho and Namibia to establish the Orange Senqu River Commission with a focus on the entire Orange River system. In the same year, the agreement on the establishment of the Limpopo Watercourse Commission with Zimbabwe, Botswana and Mozambique to "advise contracting parties …on the uses of the Limpopo, its tributaries and its waters for purposes and measures of protection, preservation and management of the Limpopo". In 2002, a multilateral agreement was signed with Mozambique and Swaziland to address a number of projects including the Joint Maputo Basin Study and the rehabilitation of the Usuthu River downstream of Swaziland.

4.3 Current water availability and use

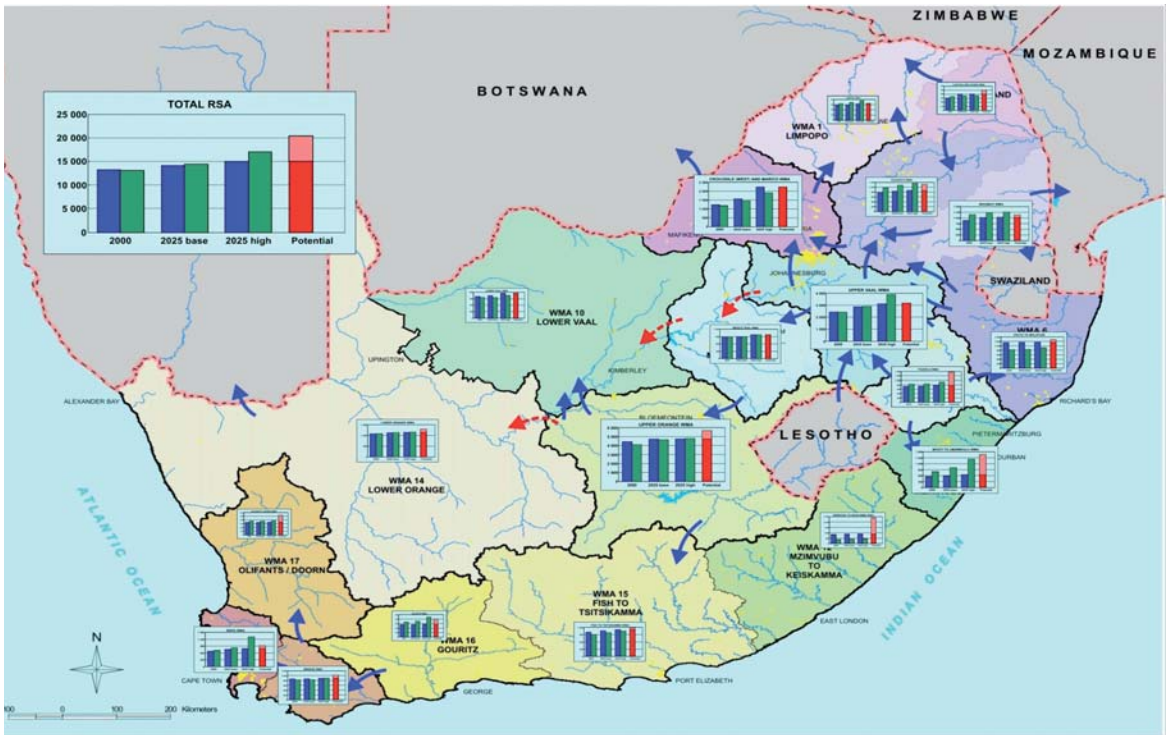
Water resources in South Africa are comprised of the following three sources in the order of magnitude: surface water (77%), return flows (14%) and groundwater (9%). There is a 98% assurance level which suggests that any peaks in future demand will result in demand exceeding supply and this is a source of vulnerability that needs to be addressed.

The following table presents the water resource allocations per water user group:

Water user/sector	Proportion of allocation
Agriculture	62%
Domestic	27%
Urban	23%
Rural	4%
Industrial	3.5%
Afforestation	3.0%
Mining	2.5%
Power generation	2.0%

The following graph presents water demand and availability projections for 2025 (National Water Resource Strategy, 2004). It compares water availability (blue bars), water use (green bars) and water development potential (red bars). It illustrates the fact that the potential for resource development exists mainly in the southern parts of KwaZulu-Natal and the eastern parts of the Eastern Cape but beyond these areas, there is limited potential for further resource development.

Figure 5: Water availability vs use



4.4 Current storage

The country has had good runoff for the last 13 years, resulting in satisfactory dam storage yielding an average of 81%. Dams in Limpopo, North West and the Eastern Cape are at a lower capacity, around 70%, whilst dams in the other provinces are well above the 81% average. In isolated cases, such as Middle Letaba, there are serious shortages affecting domestic supply.

In spite of the good runoff, the ever-present risk of drought may affect this source of water and therefore other appropriate sources must be explored. Furthermore, there are concerns about the lifespan of the

dams, the need to extend their existing capacity to promote the shift from single to multi-purpose use, as well as the need for additional dam capacity.

4.5 Current and future domestic water supply and backlogs

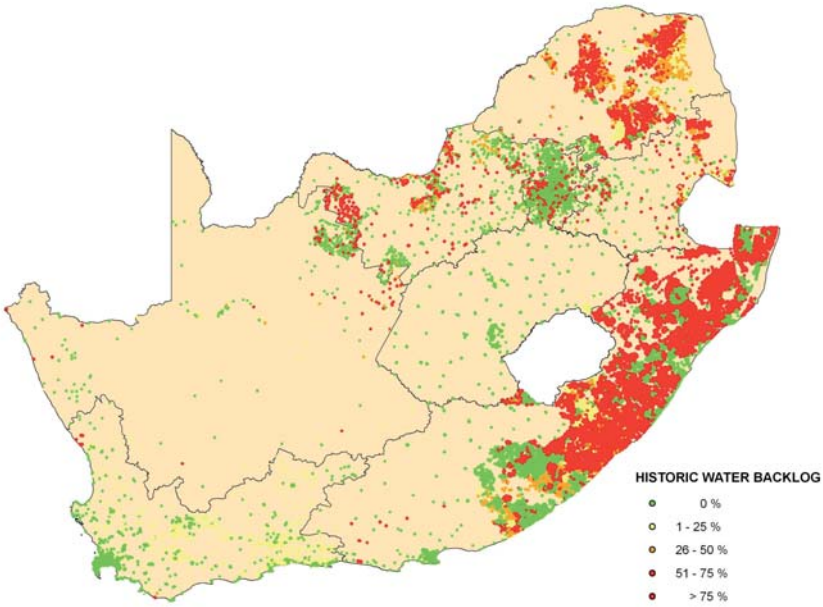
Current population projections estimate that the population will grow to 53 million people by 2025 (Stats SA). An implication from a water demand perspective is that domestic share of water use will shift from the current 27% to between 30% to 35% of the total national use. There are two primary concerns with respect to the water supplies: the first is keeping abreast of trends in population and economic growth, which have particular spatial dimensions, and the second is to address the historical basic water and sanitation service backlogs.

In 1994, South Africa's population was around 38.9 million people, three-fifths of whom (59%) had access to basic levels of water service and roughly 15.9 million people had no access to RDP (Rural Development Programme) level water supplies. There have been dramatic improvements since 1994 with almost nine-tenths of the population (88%) having access to basic service levels, and 5.7 million people, which is 12% of an estimated population of 48.7 million (Stats SA mid-year population estimate), still needing access to safe water supplies.

The following figure illustrates the spatial distribution of the formal historical basic water supply needs in the country, which are pervasive in the Eastern Cape, KwaZulu-Natal, and parts of Limpopo and the North West province. It must be noted that in spite of these backlogs, the Department achieved the Millennium Development Goals (MDG) of halving water service backlogs in 2005 and recently halved the sanitation backlog.

There are considerable constraints in eradicating these backlogs all together such as the topographical features of KwaZulu-Natal, water stress in Limpopo and limited surface water development potential in North West province.

Figure 6: Formal historic basic water supply needs



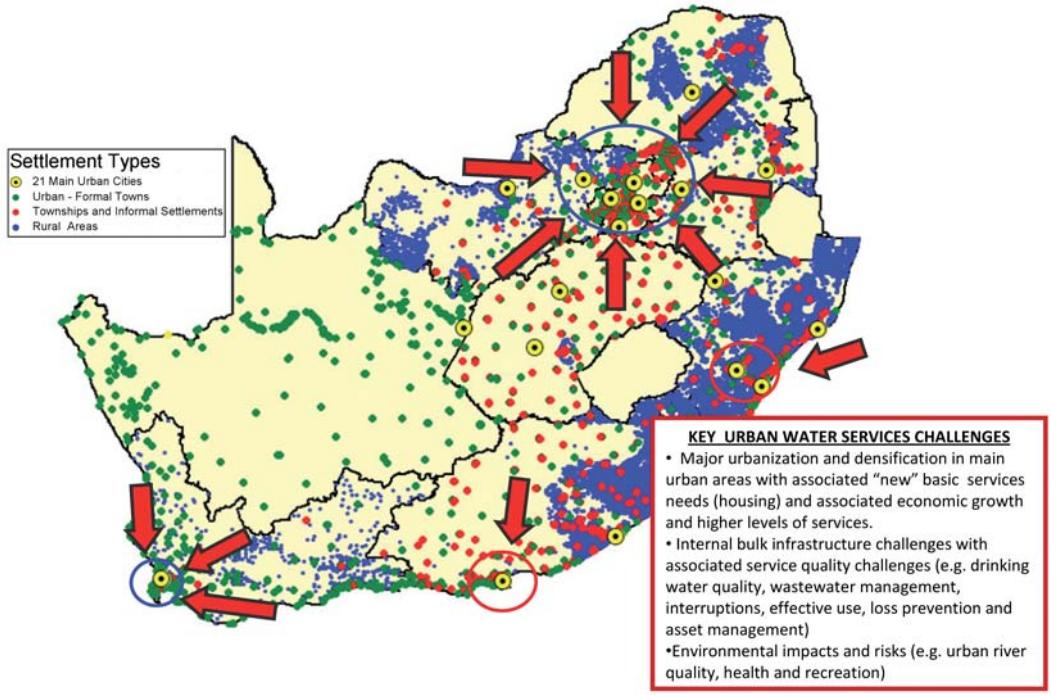
It is often assumed that the bulk of the existing backlogs are situated within water-rich or surplus areas (namely KwaZulu/Natal and the Eastern Cape) and a simplified deduction based on water availability could lead to the conclusion that the sector has failed to serve needy citizens. However, in the absence of major investment in water resource development, bulk water supply and distribution systems, available water in these provinces will not reach people. This is due to the operating challenges, which relate to high energy costs for pumping and lack of skilled operating capacity.

In Limpopo and Mpumalanga, on the other hand, the backlogs are attributed to water scarcity since human settlements are located in scarce river catchments and developments are primarily hampered by a lack

of water resources and related bulk infrastructure. Major bulk water resource development and bulk infrastructure planning and development are underway, such as the De Hoop dam, Nwamitwa. Since these developments will take several years to complete, the current backlogs will remain, and funding and capacity for interim solutions remain challenges.
In Gauteng, the historical backlog has been eradicated while the new basic services need (based on housing need) exceeds 680,000 households. The figure for the Western Cape is 400,000 households. These mostly require high level of services both for water supply and sanitation with associated financing and operating costs as well as institutional capacity.

Many water and wastewater works have reached their design capacities, are in a poor state and not properly functioning, hence resulting in major wastewater spillages and related environmental and health impacts. Bulk infrastructure development, asset management, and water quality management are priorities requiring intervention.

Figure 7: Urban water service challenges and perspectives



In summary, households that have access to an improved water supply (including those served with at, above and below RDP service level services) increased from 60% in 1995 to 95% in April 2008. For the same period access to basic sanitation services increased from 48% to 73%. The eradication of the basic water supply backlogs will increase the total domestic water use by approximately 200 million m3/annum or 6% of the current national domestic water use.

4.6 Institutional Arrangements

There is a complex set of institutional relationships that govern the water sector, involving a myriad of organizations fulfilling different roles and functions. Problems and challenges experienced in the sector are in part a consequence of these multiple institutional layers and the associated risks of performance failure by any one party as depicted in the following diagram.

Figure 8: Water Sector Institutional Arrangement

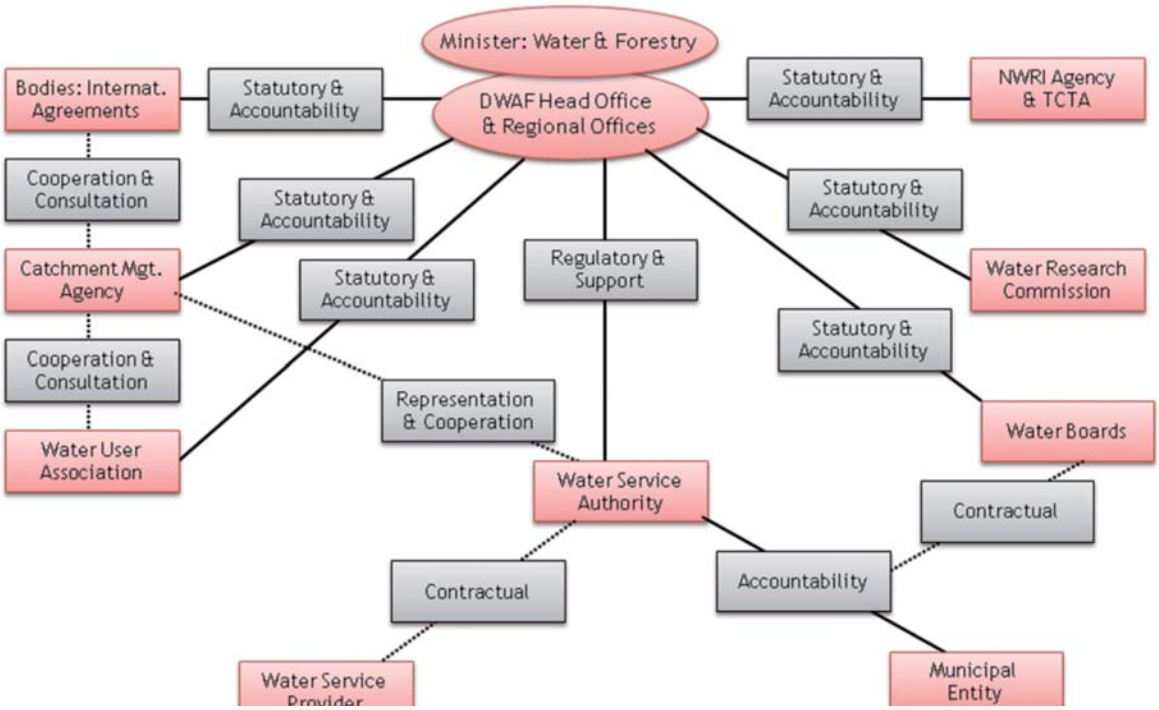


Figure 8 above illustrates the institutions that are major role players in the water sector, and that are part of the transformation of the water sector. The respective roles and responsibilities are as set out in the various policies and legislation, including the following:

- Catchment Management Agencies (CMAs) are responsible for the management of water resources at catchment and water management area (WMA) level;
- Water User Associations (WUAs) consist of an association of water users that operate within a given allocation of water at a localised level;W
- Water Services Authority (WSA) implies a municipality with powers to ensure delivery of water services;
- A municipal entity is a public entity at municipal level intended to carry out a municipal mandate; and
- Water Services Providers (WSPs) are organisations that provide water services on behalf of the WSA.

The National Water Act, No 36 1998 (NWA) also recognises that, in order to implement international agreements, specialised institutions may need to be created for this purpose, as well as institutions of support to the DWAF's mandate. In this regard, the NWA gives the Minister power to establish bodies to implement international agreements if and when the need arises. To the extent that it may not compromise its primary objective, the NWA gives the Minister the power to direct such a body to carry out additional functions. Regional cooperation is important because South Africa shares four major river basins (± 60% of land area, ± 40% of total runoff) with six neighbouring countries (DWAF, 2006).

In addition to the entities mentioned above, there are nine regional offices (one in each province of the country) that are responsible for water resource management and water services provision. These regional offices also deal with forestry issues in the northern, eastern and southern parts of the country.

4.6.1 Water resources

The process of establishing new institutional arrangements for water resource management (i.e. regional and local institutions to manage national water resources and a new institution to manage water resources infrastructure) is in its relative infancy. The South African government has approved the establishment of a National Water Resources Infrastructure Agency (a public entity) in 2005, and the agency is expected to be fully functional by 2008. The institutional reform process serves two principle purposes. Firstly, to

decentralise the responsibility for managing water resources to regional and local levels in order to facilitate wider public involvement in water matters; and secondly, to move the Department away from day-to-day water resource management activities towards its ultimate role of developing policy, regulation, planning, monitoring and providing institutional support. As part of its support role, the Department has recently embarked on the development of a capacity building strategy to address capacity limitations in the water sector.

4.6.2 Water services

Various government policies and legislation relating to water services and the role of local government have been developed and implemented since 1994. The Strategic Framework for Water Services (SFWS), which the South African government approved in 2003, provides a comprehensive summary of policy with respect to the water services environment in the country and sets out a strategic framework for its implementation over the next ten years. The changed role of DWAF is defined in the SFWS as that of sector leader and its key responsibilities entails policy formulation, support, regulation and information management.

The function of infrastructure implementation and water services scheme operation previously performed by the Department is being transferred to local government and/or appropriate water services institutions in line with the Constitutional mandate. Strategies to put the SFWS into practice are being developed and implemented and include the institutional reform of water services provision as well as regulatory and sector support strategies. Important delivery targets established in the SFWS are:

- An end to the bucket system by 2006;
- An end to the water supply backlog by 2008;
- All assets of water services schemes transferred to municipalities by 2008; and
- An end to the sanitation backlog by 2010.

The DWAF's main role is to ensure that water and sanitation services and the agencies that manage these services are sustainable and contribute to social and economic goals. As sector leader, the DWAF is therefore actively engaged in programmes such as Project Consolidate (i.e. a government initiative geard towards enhancing high standards of service delivery), to improve water management capacity in the sector in support of economic growth and development. Ensuring access to basic water supply and sanitation services remains a core priority of the DWAF and extra effort is put in place to ensure that targets set by government is achieved.

5 Water and sectors

This section of the framework profiles some of the key sectors that have significant dependencies on access to a reliable supply of water at particular levels of quality. This applies to the domestic, mining, energy, agriculture, forestry, environment, and recreation sectors.

5.1 Domestic sector

The domestic sector comprise of about 47 million people. The population is projected to reach about 53 million people by 2025 (Stats SA). Currently cities have an average population growth rate of 2.8% per year against an estimated 1.4% for the remainder of the country and a national average of less than 2.01%, and this spatial discrepancy needs to be factored into planning. An implication from a water demand perspective is that the domestic share of water use will shift from the current 27% to between 30% to 35% of the total national use.

5.1.1 Distribution of human settlements

The following map provides the spatial location and characterisation of the settlement types in the country

Of the 12 million dwellings in South Africa, 63% are classified as formal. The remainder consists of informal and backyard dwellings in urban areas, and traditional housing in rural areas.

5.1.2 Urban settlement perspective

Nearly 16 million people (37% of the population) live within South Africa's main economic centres, which cover less than 2% of the country's surface area. With 26% of household dwellings characterised as informal, a huge demand exists for formal housing – and accompanying water services.

The rapid rate of urbanisation places stresses on infrastructure. Many city sewerage networks are running close to full capacity. The pressure placed on water resources and aging infrastructure by growing demand for waterborne sanitation results in increasingly frequent failures and pollution. Furthermore, new business nodes are often established in formerly low-density residential areas that have limited infrastructure. These patterns of urban settlement are not driven by formal town and regional planning.

5.1.3 Rural settlement perspective

The rural population is an estimated 19,9 million people (or 40% of the population), living in 23,600 settlements. Nearly three-quarters (72%) of the poor live in rural areas.
Rural households are often located in scattered settlements on hillsides above flood plains to avert sub-tropical diseases associated with humid climates and water bodies. Up to 2,7 million people (6% of the national population) live in such scattered patterns. The remainder of the rural population lives in small villages, most with less than 5,000 inhabitants. Many of the larger villages are also located on hillsides and generally have unplanned layouts.

In these circumstances, to provide even a basic water supply to each household is complicated and costly. The short term needs of the most dispersed settlements are currently met by a combination of local groundwater resources, protected springs, and rainwater harvesting where possible.

5.1.4 Water Resource Implications

Urban municipal areas account for 23% of the national water use, while rural settlements use only 4%. This is partly because service levels in urban areas are much higher, but also 20% to 30% of water use in urban areas is industrial.

Growth in urban water requirements will lead to deficits in supply if demand is not managed and supply augmented. Some rural settlements already face water shortages due to lack of local water sources and drought. Based on the existing reconciliation strategies, water shortages are predicted for the majority of large towns in the short to medium term, necessitating urgent intervention.

Addressing the basic water services backlogs and ensuring universal access to water: the eradication of basic water supply backlogs will increase total domestic water usage by approximately 200 million m3/annum, equating to 6% of current national urban water use. This represents a doubling or even tripling of the current domestic water use by many rural settlements, where most of the supply backlogs are located.

Optimal service levels: The Department of Housing's Urban Development Policy is explicit about its desire for yard connections and waterborne sanitation, which has implications for the quantity of water used by the domestic sector. While the absolute number of households with on-site water has improved significantly, proportionally there has been little change, with around 21% of households without on-site water services. However, since DWAF has to achieve universal access to water services and sanitation by 2014, interim services below the prescribed RDP standards are being considered.

Economic development: Economic development leads to increased water use in cities, where most small industries are located. Projected growth rates for metropolitan areas over the next ten years vary from between 2% per annum in the slowest growing area, to 10% per annum in the fastest growing area.

5.1.5 Drinking Water Quality

All domestic water supplies have to comply with the South African National Standards specifications (SANS 241), which meets all international drinking quality standards.

Although all municipalities are legally required to monitor their drinking water quality, due to lack of capacity, not all municipalities do so on a continuous basis. To ensure compliance, the Department is developing a comprehensive monitoring and evaluation system with appropriate intervention actions.

Water resources can host diseases e.g. cholera, bilharzia and malaria as well as contain chemical contaminants injurious to human health. Reliable access to clean, safe water is a priority in the health intervention strategy and a key indicator for the MDG health goals.

5.1.6 Water Services Infrastructure

Water services infrastructure serves a critical role in the water services value chain, by linking water resources with the user/customer. Effective infrastructure planning, maintenance, operations and management require appropriate institutional capacity and financial resources.

5.2 Mining

The mining sector, a major contributor to the South African economy, presents particular challenges in reconciling the needs for growth with the protection and sustainability of water resources. Not only is the sector a major consumer of water, but acid mine drainage from abandoned mines represents a serious and complex threat to water quality.

Mining takes place throughout the country, but is most concentrated in the dryer interior, where the industry is supplied by three main rivers: the Vaal, Crocodile West, and Olifants rivers.

The expansion of chrome and platinum mining developments in Limpopo and Mpumalanga is being supported by the development of the De Hoop dam on the Olifants, but further development of this resource will require either the repurposing of irrigation water, or transfers from other rivers.

5.3 Energy

In terms of meeting the country's energy and fuel requirements, the provision of water to both Eskom and Sasol's operations is necessary to support economic growth targets and household consumption needs. Currently, the Vaal River System supplies both Eskom's large coal-fired power stations and Sasol's large coal-to-liquid plants (Sasol1, Sasolburg and Sasol 2 & 3, Secunda). The Vaal River Eastern Sub-system Augmentation Pipeline is underway to augment the water supply to the power stations and Sasol 2 and 3.

Historically highly water-intensive, Eskom power stations are using less water due to the transition from "wet-cooled" to "dry-cooled" technology reducing the average water consumption nine-fold. The application of this technology has increased the costs of building and operating power stations but was necessitated by the availability of water.

In light of the current energy crisis in the country, there are plans afoot to build new coal-fired power stations and this will most likely take place on the Waterberg coalfields near Lephalale, Limpopo Province. The closest supply of water is the Mokolo Dam but since it does not have an adequate supply of water, water is likely to be transferred from the Crocodile (West) River with growing return flows from the northern urban and industrial areas of Gauteng. A feasibility study is underway and this pipeline may be operational by 2012.

Sasol is also expanding its operations and is investigating the possibility of building additional coal-to-liquid fuel plants, referred to as Mafutha 1 and 2. Since these plants require large quantities of water, their location will be determined by the most accessible and adequate supply of water and two main options are currently under consideration.

5.4 Agriculture

Agriculture forms an important although relatively small part of the South African economy, contributing to 4% of the GDP. However, the agro processing industry, which is indirectly dependent on irrigation, makes up 20% of South Africa's GDP and is an important source of foreign exchange earnings. It is also a crucial source of employment, particularly in rural areas, employing 15% of the labour force.
The agricultural sector is the largest water user in the country, consuming almost 60% of the entire available water resources. The challenge is to achieve a higher output with the same or less water. It is essential to enhance the productivity of water, and thereby improve the competitiveness of domestic agriculture in the global economy. Agriculture is also facing increasing competition for water resources from domestic and industrial users.

When anticipating the water requirements of irrigated agriculture, the Department takes into account the segmented nature of the sector, which can be broadly categorised into large and small-scale commercial

agriculture, and small-scale irrigation for community and household food security.

A major development in the irrigation sector is the significant increase in the use of groundwater for irrigation purposes, which is attributed to the use of centre pivot irrigation.

The Department acknowledges the new Irrigation Development Strategy by the Department of Agriculture, which proposes 600,000 ha of additional land under irrigation as a result of water-loss savings and improved irrigation efficiency. This includes the rehabilitation of existing irrigation schemes in the former homelands and the use of water already allocated to agriculture that has not been used up to date. The Department also anticipates the improvement of irrigation methods such as drip irrigation and where feasible the conversion to appropriate crops and livestock.

5.5 Forestry

South Africa's forest resources consist of woodlands, indigenous forests, and plantations. The Department's 2003 vision and mission commits the Department to ensuring that 'Forests are managed for people and the need to create an enabling environment for economic and social development through sustainable forest management at the local level'.

With 82% of its plantations internationally certified, South Africa is the world leader in terms of environmental certification. Of the 1,3 million ha of plantations in South Africa, over 80% are situated in Mpumalanga, KwaZulu-Natal, and the Eastern Cape.

5.5.1 Economic and Financial Implications

This sector provides employment for about 107,000 people, of which 69,556 are in formal employment, 13,274 are contract workers and 24,170 small growers and their staff.

Furthermore, plantations provide raw material for downstream activities such as pulp milling, paper manufacturing, saw milling, wood chip exports, timber board, mining timber, and treated poles, which in turn represented an income of around R 16,123 billion in 2006. More than 63,000 people are employed in the wood processing sector.

The total value of reported sales of timber-based products in 2005/06 amounted to R16,123 billion, an increase of 7.3% on the 2004/05 period. Woodpulp and paper products dominate the industry, accounting for R6,891 billion or 42.7% of the industry.

Timber sales for mining purposes have decreased over the past reporting period, while the sale of chips for export to the Far East has remained more constant.

The rate of new afforestation declined considerably in recent years, primarily due to the increased scarcity of suitable land and high licensing costs. However, due to the efforts of DWAF and other affected departments and stakeholders in identifying suitable land for forestry, applications for planting timber grew to 5,500 ha from just 800 ha in 2004. The private sector was responsible for 99,2 % of the reported new afforestation.

5.5.2 Natural Forests and Woodlands

Although natural forests cover less than 1% of the country's land surface, they harbour an average of 418 plant and animal species per hectare. According to a 2003 baseline study, woodlands occur on 29 302 316 ha or some 24% of the land area.

Tourism associated with natural forests and woodlands contributes significantly to the economy, but the contribution forests make to rural livelihoods in terms of fuel, building materials, food, natural medicines, raw materials for crafts, and a host of other non-timber forest products is even more significant.

5.6 Environment

South Africa depends on its water resources to provide for its social and economic needs and to support the environment to ensure long term sustainable use. However, since water is a scarce resource and is unevenly distributed throughout the country, it is one of the limiting factors to the nation's economic production and growth - in short, society cannot sustain any economic activity without the goods and services provided by water resources. For these reasons, an integrated approach to water resource management is required that promotes the coordinated development and management of water resources to maximise social and economic development, while ensuring equitable and sustainable utilisation of the resource.

If properly managed, water resources can be utilised indefinitely, allowing people to benefit from their innate ability to recover and reset themselves over time. However, exploitation of land and water resources without understanding their limits can affect catchment processes and functions, and impact negatively on the ecology that has evolved over millions of years. When the balance, resilience, integrity and ecological health of water resources is disturbed, they can become dominated by one or a few hardy organisms, such as blackfly, algae, or introduced pests such as water hyacinth, which have no natural enemies here. Alternatively, when water resources are over-utilised, rivers that once flowed permanently may stop or wetlands dry up. If such levels of exploitation are allowed, the rights of downstream users are impacted on.

Water is well recognised as an economic good, and is often viewed as a social good whose value can be measured, but the value of aquatic ecosystems is less understood. Aquatic ecosystems offer valuable goods, services and attributes that contribute to human welfare and have economic value. Resources that can be harvested, such as fish and reeds are considered to be goods, while services are processes offered by water resources such as water purification, water storage, and transport. The attributes of water resources include beauty, educational, cultural, spiritual and recreational aspects. Aquatic ecosystem goods are critical for the poor, who often depend on them for their livelihoods. Changes in availability of these services affect the wellbeing of the poor. Tourism opportunities based on the inherent natural beauty of a location have the potential to create jobs with far fewer negative impacts on the natural environment than industrial or mining developments.

5.7 Recreation

Recreation in South Africa is highly dependent on water availability and quality and underpins South Africa's ecotourism sector, an increasingly important economic sector.

Due to South Africa's hot climate, many urban households have swimming pools or share in a municipal swimming facility. Together with water parks, fountains, and water features, these consume significant volumes of water due to high evaporation rates and other losses. Municipalities also irrigate parks and recreational areas during dry seasons, which is partly done through re-use of municipal waste water, where possible, or through the water supply systems.

Many high value residential developments are taking place at or near rivers and water bodies due to the increased property value associated with recreational water uses and the scenic setting associated with water bodies. Examples include Hartebeespoort Dam, Vaal River and Dam, urban lakes and rivers, and Pongolapoort Dam. Unfortunately, this often leads to environmental impact on riverine ecologies and water pollution. In some cases the natural river flows are changed and/or impounded, thereby affecting water quality, aquatic life and causing increased evaporation losses.

Urban growth also results in increased recreational use of nearby dams, rivers, and natural lakes. Access to, and use of, water bodies affect the environment in general, and water quality in particular. Water use must therefore be managed effectively and with the necessary precautions to prevent pollution resulting from recreational use.

5.8 Establishing the economic value of water

The following table provides a preliminary indication of the economic value of water to a selection of sectors:

Sector	Gross Domestic roduct R/m3	Employment number Mm3	Low Income Households R/m3
Urban sector: Commercial and industrial consumers	R498.83	1,745.73	R158.47
Rural – subsistence agriculture	R0.89	21.64	R0.17
Commercial irrigation	R2.80	133.79	R0.70
Commercial forestry	R1.96	57.02	R0.31

The Department intends to refine and extend this analysis of the economic value of water for a number of reasons. Firstly, in light of its commitment to water redress, the Department needs to make informed decisions in respect to its Water Allocation Reform programme. Secondly, it assists the Department in understanding where it needs to focus its efforts with regards to Water Conservation and Water Demand Management. Thirdly, it wishes to ensure that water allocations achieve the best possible economic returns as water is an increasingly scarce resource.

6 Risks, threats and challenges

There are several dominant risks, threats and challenges to the country being able to sustainably supply water to meet growth and development needs into the future. These include water availability, climate change, infrastructure, human resources, compliance and enforcement, raw water quality, financial support and water pricing.

6.1 Climate change

Climate change is an accepted threat to the sustainability of water supplies as highlighted by the Inter-Governmental Panel on Climate Change's technical report. What is uncertain is the quantification of the impact, and this complicates the planning required to ensure sufficient future water supplies. For this reason, it is vital that the department participates in, contributes to, and supports ongoing research and monitoring of the effects of climate change on the sub-region and continent.

The Department's potential impact on mitigation of climate change is relatively small, and probably lies most in leveraging other government departments that have a greater impact on carbon emissions. However, in terms of mitigation, the department should ensure that carbon accounting forms part of the planning process for all major projects.

The critical role of climate change in relation to DWAF planning processes is in terms adaptation. All scenario planning must factor in the predicted future impacts of climate change. This in turn requires research to be disseminated within the department, and water sector in general.

It is likely that the net effect of climate change will be to reduce availability of water, although these effects will be unevenly distributed, with the eastern coastal regions of the country possibly becoming wetter. In the interior and the western parts of the country climate change is likely to lead to more intense and prolonged periods of drought. In general, climate change is likely to lead to weather events that are more intense and variable than in the past, e.g. sudden high volumes of rain fall leading to flooding.

In addition to the general challenges to water security posed by the net drying effects of climate change in some areas, the increased variability of rainfall presents specific challenges. Even where average annual rainfall remains constant, increased variability in rainfall patterns will result in less reliable stream flows and consequent increases in the unit costs of water from dams. The effects of increased evaporation due to higher temperatures, particularly in relation to large, shallow dams, need to be considered in deciding upon new dam constructions versus enhancing groundwater resources. Coupled with more uneven and

less predictable distribution patterns for rainfall, increased inconsistency of supply represents a challenge in resource management.

Periods of unusually low river flow present a problem in terms of the dilution of wastewater and effluent, with concomitant health risks. With this in mind, and bearing in mind the general challenges to the water resource, in some areas it may be necessary to reconsider priorities in terms of replacing dry sanitation with water-borne systems. Conversely, sudden flood events are also known vectors for the spread of water-borne disease, such as cholera – particularly in areas where urban drainage is not designed to cope with flooding. For these reasons, research into the impact of climate change on water quality and public health is needed to inform policy formulation.

Climate change also presents particular challenges to water infrastructure. More extreme wetting and drying cycles result in greater soil movement and make water and sewerage pipes more prone to cracking. Increases in intense rainfall events will place soil dams at risk and increase siltation of dams and estuaries. Coupled with higher temperatures, intense rainfall effects also cause problems with water quality in terms of colour and odour.

6.2 Acid Mine Drainage

Groundwater pollution and surface water pollution as a result of acid mine drainage from abandoned mines poses both a serious environmental threat and an obstacle to securing water for growth and development. In the central and western basins of the Witwatersrand mine systems, this threat is present and immediate, and requires urgent intervention. However, the problem has a medium and long term scope, with potential for ingress of acid mine drainage into the water table for centuries to come.

Acid mine drainage (AMD) poses a threat to water quality in terms of salinity, and levels of sulphates and heavy metals. Although AMD discharge from the Witwatersrand basins currently accounts for only 5% of the volume of water in the Vaal River, it accounts for 20% of the salinity that could include heavy metals.

The immediate crisis with AMD in the Witwatersrand began in 2002 with the flooding of the Western basin at a rate of 20 mega litres per day, requiring the Department to issue a directive to the relevant mining companies for the treatment of the affected water to a specified quality. Despite significant investment by the mines in treatment facilities, the water standards specified in the directive have not been met and partially treated water is currently discharged into the Tweelopies Spruit. This situation has already resulted in the contamination of downstream boreholes and other environmental damage and if continued is likely to result in significant claims for compensation.

As a consequence of the absence of operational pumping facilities, the Central Basin has flooded to within 900m of the surface, threatening the perched aquifer above the AMD. Various studies predict that the AMD will entirely decant into the central basin within three and half years. This situation not only represents a potential environmental catastrophe, but threatens the structural integrity of the Johannesburg City Centre.

6.3 Natural Resource Management

A critical threat to water for growth and development in South Africa is natural resource degradation. Invasive alien plant species tend to use more water than the indigenous plants that they displace, and decrease the mean annual runoff. Climate change could exacerbate the impact even further.

In addition to their impact on water quantity, invasive alien plant species reduce stream-flow, degrade river banks, and increase erosion, cause silting up of dams and estuaries, eutrophication, thermal pollution, light pollution, increased risks of flooding, destruction of infrastructure, and reduced biological diversity. They generally impact negatively on the integrity and functioning of both terrestrial and aquatic systems, thereby reducing the productive use of land. All these factors influence water for growth and development, and this is recognized through the investment in the Working for Water programme.

A second major consideration in natural resource management is that of wetland conservation. South Africa has almost 120,000 known wetlands, more than half of which are destroyed or degraded. The impact water quantity, water quality (wetlands being known as the "kidneys of natural systems"), flood attenuation, tourism and recreation, biological diversity and food security, point to this being a second major factor for water for growth and development. This has been reflected in the development of the Working for Wetlands programme.

Linked to the above concerns have been land-use practices, including the use of inappropriate agricultural practices, and the impact that these have on water security. The need to rehabilitate degraded land, which benefits water, erosion, siltation and carbon sequestration, is pivotal for water for growth and development (for, of course, growth and development can only take place with a variety of measures that are addressed, one of which is water). The Working for Woodlands programme, in concert with the LandCare programme, is a response to this.

A fourth major consideration is wild fires. While wild fires are essential to the ecological cycle in fire-prone vegetation, the acceleration and intensity of wild fires (often exacerbated by invasive alien plants) impacts on water security (water quality and water quantity), habitat destruction, impacts on life and livelihoods, flooding and other impacts, once again illustrate the need for an integrated approach to dealing with water for growth and development. The Working on Fire programme is a response to this.

6.4 Infrastructure

6.4.1 Water resources

There is a need to invest in the upgrading of current infrastructure since the majority of capital investments were made in the 1970s and 1980s. Most assets are thus approaching the end of their useful life, which means funding will be required for major rehabilitation to extend the lifespan of these assets. The capital replacement cost (CRC) of poor condition assets amounts to about R6.4 billion and there is a maintenance backlog for those assets deemed to be in good condition. About R4 billion per annum is required to renew or rehabilitate this infrastructure and the bulk of the rehabilitation for the next 30 years will be on canals and tunnels, which mainly supply irrigation.

Further analysis of the scheduled replacement costs per asset type is required to differentiate between critical and non-critical assets. The critical assets have to be prioritized and may even be brought forward into the first 10-year period. It may be possible to defer some of the non-critical assets such as secondary and tertiary canal systems, until there are lowered replacement needs, whilst accepting the related impacts such as water loss, lowering of service levels, reduced revenue streams, and strained relationships with customers.

6.4.2 Water services

There is an ongoing need to sustain the process of addressing water supply backlogs, which invariably requires continued investment in new infrastructure in areas that lack safe water supplies. This has to be balanced against the need to maintain existing water services infrastructure. Water Service Institutions (WSIs) are expected to develop and apply Infrastructure Asset Management (IAM) through their Water Services Development Plans (WSDPs) and water board business plans. A drawback of these plans is their tendency to focus on the development of new infrastructure to address basic service backlogs at the expense of the IAM requirements of existing infrastructure.

Unless IAM requirements are planned for, funds to address the cost of unplanned repairs and replacements may have to be prioritised over new construction, which would severely limit the programme for addressing backlogs and expanding service delivery. Current reasons for this lack of adherence include:

- lack of skilled contractors to render services and poor construction supervision, which diminishes the life expectancy of infrastructure
- lack of municipal staff to operate and maintain water services infrastructure
- absent or weak municipal systems for infrastructure management.

The result is poor service quality leading to customer dissatisfaction and non-payment of services. This, in turn, impacts the financial viability of schemes and compromises the WSIs ability to provide effective services.

Of particular concern is the status of the Waste Water Treatment Works, which are affected by failing infrastructure (water purification and reticulation infrastructure), poor waste water collection and treatment systems, and lack of human resources (capacity and skills) to meet effluent standards. The impact of poorly managed Waste Water Treatment Works is the inability to sustain safe drinking water quality.

6.5 Skills shortages

The water management sector is experiencing skills shortages in respect to engineering, scientific, technical, and artisanal areas of skill, and which are accordingly classified as scarce and critical skills. This is largely attributed to an insufficient skills base and fierce competition in the sector for skilled personnel. Huge losses in institutional memory and strategic and operational decision-making capabilities also have a major impact.

As one indicator of skills shortage in the sector, the following graph captures skills shortages in respect to civil engineering professionals within local municipalities. It illustrates the extreme shortages in many municipalities that affect their ability to maintain and expand water management and supply systems and processes.

6.6 Compliance and enforcement

There is major concern about the extent of unlawful water use and pollution – the abuse of the Vaal River system epitomises this behaviour - resulting in the quantity of water being used exceeding the respective systems' yield and pollution of fresh water resource resulting in eutrophication (lack of oxygen in the water).

In the Vaal River system, the unlawful use of water by irrigators is a major problem, particularly upstream from the Vaal Dam. This water is, in effect, supplied by the Lesotho Highlands Water Project (LHWP), and the current volume of water abstracted illegally along the Vaal is equivalent to the yield of the new Mohale Dam.

As a consequence of unlawful water use, the system yield was exceeded by total use in 2007. The impact is the same as if the tunnel between the Mohale and Katse Dams collapsed and Phase 1B was effectively cut off from the system. A R7,8 billion project to ensure sufficient water for Gauteng has effectively been neutralized through theft of this water. This is also masked by good rainfall and run-off but this could change dramatically under drought conditions.

Pollution of water resources is attributed to the impact of mining activities leading to heavy metal contamination as a result of acid mine drainage; poor agricultural practices resulting in increasing salt loads; and urbanisation and industry-related activities.

6.7 Raw water quality

There is concern about the declining quality of water in rivers and dams as a result of pollution and poor land use management and its socio-economic and environmental impacts. Examples of economic impacts include costs borne by Eskom because the quality of water does not meet the design specifications of its power stations. Social impacts include negative health impacts and ensuing consequence such as loss of life and productivity. Environmental impacts include eutrophication and groundwater contamination.

Sources of pollution include the agricultural and industrial activities, poorly managed waste water treatment works, and human settlements.

7 Current interventions

7.1 An overview of existing planning interventions

The **Water for Growth and Development (WfGD**) framework is a planning programme ensuring continued water to developing areas. It is supported by existing legislation and policy but needs continued political support. This programme is in line with the Strategic Framework for Water Services (SFWS) and the National Water Resource Strategy (NWRS).
National development plans need to take due cognisance of the constraints imposed by water scarcity, and planning should include consideration of technical, economic, socio-economic and environmental impacts.

Based on the conclusion that the **National Spatial Development Perspective (NSDP)** should

inform the development plans, policies and programmes of all spheres and agencies of government as a matter of policy, DWAF has produced reconciliation strategies for most of the 26 key national growth points as identified by the NSDP, and will be further expanded to cover the whole country.

The **National Water Resource Strategy (NWRS)** provides a clear indication of the overall state of the country's water resources and provides a number of measures to optimise and extend the availability and use of water, offering strategies towards equitable, sustainable and efficient use in line with NWA principles. The Department is embarking on the revision of the NWRS to maintain its relevance.

The **Strategic Framework for Water Resources (SFWR)** sets out a comprehensive approach with respect to the provision of water resources, ranging from small rural areas to industries in the largest urban areas. It outlines the change in approach needed to achieve policy goals. Water services refer to water supply and sanitation services and include regional water schemes, local water schemes, on-site sanitation and the collection and treatment of wastewater.

The **Internal Strategic Perspectives (ISPs**) can be viewed as regional strategy tools, ISPs have been developed for each of the 19 Water Management Areas (WMAs), serving the purpose of refining the water resource information and providing a review of each area in terms of resource availability and management.

Reconciliation Strategies: The Department has embarked upon a process of preparing reconciliation strategies throughout the country, looking at water requirements (based on use, estimated need and projected need), at water availability (ability to meet those demands), and at the overall resource situation - in terms of infrastructure and affordability - to ways of reducing demand and increasing availability. The approach to water resource reconciliation is set out in a strategy that recommends actions to ensure sufficient water. These strategies could vary from complex, in the case of major metropolitan areas and systems and catchments, to simple strategies for smaller towns.

The key objectives of the reconciliation study are to develop future water requirement scenarios, investigate all possible water sources and methods for reconciling, provide recommendations for interventions and actions and offer a system for continuous updating in the future.

Current completed studies include the Western Cape Water Supply System: Reconciliation Strategy Study and the Reconciliation Strategy for the Amatole Bulk Water supply System.

Studies in progress include the Vaal River System: Large Bulk Water Supply Reconciliation Strategies; the Crocodile (West) Reconciliation Strategy Study; the Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas; and the Algoa Water Supply Area.

Further studies are planned, and the process will be taken forward by Strategy Steering Committees, which will monitor the actual water use, assess the results from further planning studies and make recommendations on the implementation of interventions.

The next step is to extend the reconciliation strategies to all other towns, which will provide first-order reconciliation strategies for all towns in South Africa over the next three years. These strategies should give clear direction to municipal managers on the best sources of water supply for their development needs.

7.2 Other planning interventions

7.2.1 Water Services Infrastructure

Recent work in assessing and documenting the state of water services infrastructure served to underline the need for a **National Water Services Infrastructure Asset Management (IAM) Strategy**. This strategy aims to avoid infrastructure deteriorating to crisis levels, there by negating the impact and affect on national government's growth and poverty reduction targets.

7.2.2 Skills Development Initiatives

A number of skills development initiatives have been put in place in the water sector, with some success in terms of training in scarce skills.

A Water Sector Support Coordinating Unit (WSSCU) was established in 2007 and focuses on the

acceleration of basic water services delivery by identifying and addressing project implementation bottlenecks in DWAF and municipalities. Hands-on engineering and technical support is provided through the Development Bank of Southern Africa's Siyenza Manje programme, the SAICE/SABTACO deployment programme (known as ENERGYS – Engineers Now to Ensure Roll-out by Growing Young Skills), and the Masenzani Management Support Contract.

The WSSCU has begun to explore partnership arrangements with various organisations, and has established a relationship with DWAF Forestry and Water Learning Academy to identify how short-term deployments in the sector can be linked with on-site training programmes.

7.2.3 Raw Water Quality Management and Pollution Control

Initiatives in this area focus on compliance, monitoring and enforcement. There has been a shift in DWAF's approach to municipalities that do not meet compliance standards in terms of the management of their Waste Water Treatment Works.

DWAF is developing its small Compliance, Monitoring and Enforcement (CME) Units, the regional teams of which will move into the CMAs as they are established.

Due to a previously poor past track record in completing cases against offenders, DWAF's CME Units are now working in partnership with South African Police Services, the Department of Environmental Affairs and Tourism (DEAT), the National Intelligence Agency, the South African Revenue Services and the Department of Agriculture (DoA), as well as being part of the Environmental Prosecuting Forum. The National Environmental Management Act is currently being amended to enable the appointment of DWAF officials as environmental management inspectors with the associated powers.

7.2.4 Water for development

Since 1994, the water sector has implemented various policies and programmes with associated funding to support service delivery, job creation and poverty alleviation, such as the roll-out of the Free Basic Water Policy; Financial Support for Resource Poor Farmer Policy & Supporting Regulations; the Water Allocation Reform, Working for Water and the Masibambane I, II & III programmes. These programmes remain vital to the WfGD programme.

Through these and other programmes, the water sector has achieved successes in the establishment of Catchment Management Agencies, Water Allocation Reform, improvement in raw water quality and effluent management; better management of bulk water infrastructure; more effective regulation; implementation of WC/WDM programmes; improvement in Drinking Water Quality and progress in addressing sanitation backlogs.

Working for Water (WfW) is an Extended Public Works Programme (EPWP), administered by DWAF on behalf of DWAF, DEAT and DoA, which seeks to effectively manage invasive alien plants in South Africa in a labour intensive way that optimizes the socio-economic empowerment opportunities presented by the programme. Since its inception, WfW has generated employment opportunities through more than 300 projects and has also supported value-added industrial projects through capacity development.
There are also significant socio-economic benefits of large water resource development projects. Investment in new large water resource projects, such as dams, bulk water pipelines, pumping station and reservoirs that are located in economically depressed areas can yield benefits for local communities. The Thukela Water Project, for example, created employment, increased skills levels in the community, boosted the local economy and improved infrastructure. The De Hoop Dam Project created similar benefits, and this was done as part of a Charter, which set targets for Social and Economic Development, and was managed through the establishment of an Authorities Coordination Committee.

8 Options and choices

This section of the framework details the options and choices that the Department, government and other stakeholders will have to consider when focusing its decision-making to ensure that water management and use optimizes the twin goals of growth and development.

The section begins with a discussion of the range of instruments that are available to the Department

to effect behaviour change with respect to water use. This is followed by a discussion of the range of options available to the Department with respect to securing water availability that goes far beyond the conventional means of water augmentation schemes. The remainder of the section offers further detail on supply-side management and demand-side management interventions, climate change, interventions for 'water for growth' and 'water for development' and lastly, water governance and co-operative planning.

8.1 Reconciliation strategies: balancing supply and demand

The approach towards determining and planning for water resource sufficiency and sustainability is through Reconciliation Strategies that have already been developed for the major metropolitan areas, or must now be developed for the remaining areas.

It is essential that these strategies be undertaken and updated to cover all metropolitan areas and towns in the country and ultimately need to include all water users. The reconciliation process must be supported through to implementation and meaningful handover to relevant authorities. Strategies must be adapted as the future unfolds and Strategy Steering Committees, comprising of all major stakeholders, are being established for the metropolitan areas to monitor implementation and allow for appropriate adjustments and timely interventions.

Water demand must be managed and water used as efficiently as possible. All supply side options must be considered, as will be discussed in the following section.

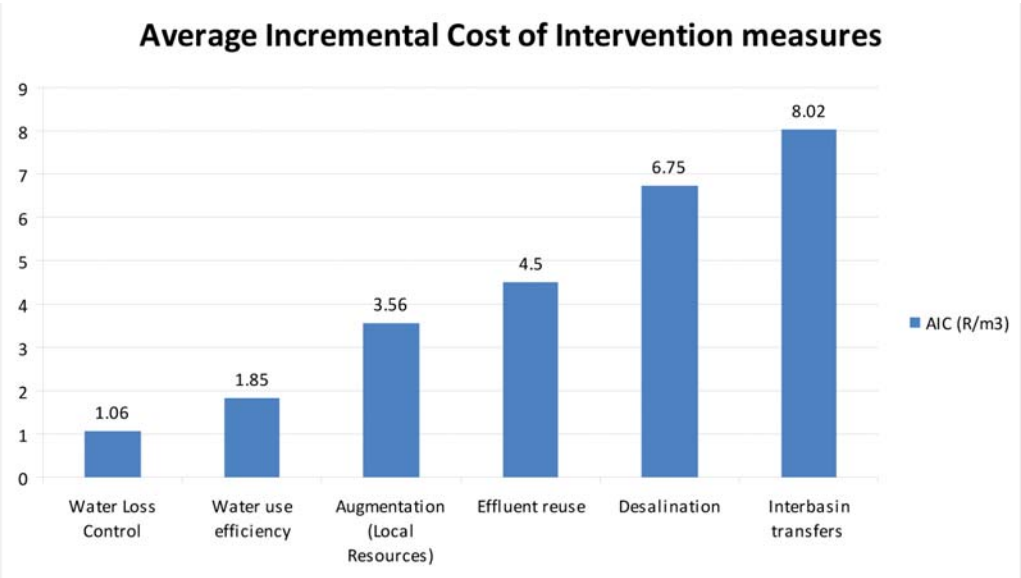
8.2 Options for water security

8.2.1 An overview of water resource options

Historically, investment by the Department in securing water supplies took the form of dams, reservoirs and accompanying infrastructure. Most of the best dam sites have been developed and there is currently very little potential in this regard apart from some parts of KwaZulu-Natal and the Eastern Cape. With the emerging findings of the reconciliation strategies and potential water shortages in South Africa's largest urban centres, the Department must consider other viable water supplies to serve the varying needs of each water-reliant sector.

Apart from traditional augmentation schemes, other water supply options include effluent re-use, desalination and inter-basin transfers. Demand-supply options include water loss control and water use efficiency.

The graph below provides an indicative costing based on a case study of the marginal cost of water supply in the municipal sector. It is important to note the general trends in this graph are based on the least cost where there is potential in implementing all the intervention measures.



While the graph does not depict actual marginal cost of the different intervention options as these costs will vary on a project-by-project basis, it highlights the fact that the Department has a range of options to consider when addressing water security in particular localities and it expects interventions to be as cost-effective and practical as possible.

8.2.2 Future water mix

The following matrix provides a high level perspective of the potential shifts in the water mix being anticipated by the Department.

Table 1 A long term national view of the potential combination of main water sources

Water source	2008	Mid-term 2025	Long-term 2040
Surface water	77%	72%	65%
Groundwater	8%	10%	12%
Re-turn flows (irrigation, treated effluent and mining)	15%	19%	25%
Desalination	<1%	5%	7%

Notes on assumptions:

- 2025 and 2040 water requirements based on high growth scenario. No additional water for irrigation assumed.
- Only surface water resources that at present appear likely to be developed, were taken into account.
- Groundwater development assumed for rural areas and for some bulk schemes.
- All inland return flows discharged into rivers and groundwater resources, therefore available for indirect re-use. Coastal areas at present discharge most treated effluent to sea, re-use schemes could be implemented by supply of treated effluent to agricultural users or by returning treated effluent to surface sources or artificially recharge groundwater sources. Available supply for urban uses could be increased.
- Desalination includes treatment of seawater and brackish groundwater.
- Increase in groundwater, return-flow use and desalination may seem small, but volumes are big and would need major effort and resources to achieve.

In the long-term, while surface water will remain the predominant source of water, the Department expects surface water to contribute proportionately less with proportionately significant increases in return flows through the treatment of urban and mining effluent and desalination.

Options for water supply must be considered beyond the traditional river storage options. In order to assess the requirements for water supply, it is important to consider all options on both the demand and supply side. The Department will ensure that cost-benefit analyses will factor in total benefit and not be limited to direct capital and operational costs so that its decision-making factors in full costs, including environmental costs.

8.2.3 Groundwater use and treatment

Groundwater, historically regarded as 'private' water in South Africa, was declared a public resource under the National Water Act of 1998. The country has yet to catch up with the implications of this change. Surface water has been the focus of policy, with groundwater relegated and only seriously factored in during emergencies. Groundwater must, however, be "mainstreamed" alongside surface water as a key resource, the proper use of which will enhance the total available water supply.

Groundwater offers a significant volume of additional water to agriculture, the mining sector, towns, and rural communities. For many towns and rural communities, it is often the only available and affordable supply of water capable of supporting future growth and development. Although groundwater is widely accessible and often close to the point of use, planners and consumers frequently either do not recognise it as a resource, or shun it as inferior to surface water.

Groundwater is critical to many Karoo and coastal towns. Dolomitic aquifers are a major fresh water source in the North West Province (e.g. Tosca). Agricultural developments ranging from potatoes in the Sandveld, to tomatoes in Dendron, depend on groundwater. Cape Town and Oudtshoorn are exploring the

Table Mountain Group Aquifer as a major source of water to use in conjunction with surface supplies. Groundwater supplies rural communities from the Eastern Cape (former Transkei areas) to Limpopo and in time may supply up to 20% of the country's water. Most importantly, as an under-exploited resource, groundwater offers a relatively conflict-free way of providing water to rural communities across the country.

It is possible to treat brackish groundwater in areas of poor water quality. Generally, it is close to the point of demand and its benefits include increased water assurance, reduced risk of water restrictions, and minimal evaporation losses. As a source of emergency supplies, groundwater requires relatively short lead times for implementation.

The Department has highlighted the importance of groundwater in integrated water resource management. To exploit groundwater effectively, DWAF will invest accordingly to quantify as accurately as possible resource volumes at a scale useful to planners and users at local level. At present, the country lacks the depth in skills and leadership in hydrogeology to drive the understanding and acceptance of groundwater from national down to local management level. Steps must be taken to strengthen geohydrological skills and build technical training capacity at institutions across the country.

The sustainable use of groundwater requires the careful initial siting of boreholes and subsequent monitoring and management to ensure that water use does not exceed supply. As with all water resources, successful use depends entirely on sound management and this is particularly important where the supply is "invisible" to the user. The Department is currently in the process of developing a National Groundwater Strategy that will address these issues and provide a way forward.

8.2.4 Water recycling/return flows

Water recycling may take a number of forms, each with substantially different costs, yield quantities, and value to the end user. The various forms include:

- **Industrial reuse:** commercial users may use water in cooling, wash-down or other industrial processes. In some cases, recycled water can be treated through reverse osmosis or similar processes to obtain a high quality water product. The quantity of water that can be recycled is determined by the number of industries that can make use of recycled water in their processes within close proximity to a wastewater treatment plant. .

- **Agricultural reuse:** substantial volumes of recycled water could be made available for agricultural use. However, in many cases, the distances between wastewater treatment plants and potential irrigation areas would mean prohibitively high costs.

- **Third pipe residential:** treated wastewater can potentially be used for non-drinking purposes such as garden watering and toilet flushing. Although there are no third pipe schemes in South Africa, there may be benefits in implementing these schemes. The benefits of third pipe schemes often hinge on cost reductions in other parts of the water supply or wastewater system. Since most domestic water use is non-consumptive, the re-use of water should be considered wherever possible. This needs to be implemented in conjunction with other demand and conservation measures to ensure that the country's limited water resources will be adequate for the growth in domestic water demands.

- **Indirect potable reuse:** water can be treated to an extremely high quality and then returned into a river, surface- or ground-water supply for eventual re-extraction and use in the potable water supply system. Although this is being done in some highly water stressed areas, such as the Crocodile (West) River system, there is scope for increasing indirect potable reuse.

The Reconciliation Strategy studies for the metropolitan areas have identified the use of treated effluent as a major potential source of water, particularly in coastal cities where most effluent is currently discharged into the sea. Limited re-use of water for industrial purposes is already being practised in almost all of the coastal cities.

The benefits of treated effluent include the immediate availability of the water resource with high assurance of supply and water is already being treated through invested costs of infrastructure and human resources. Where current treatment does not adhere to standards for discharge to rivers, the treated effluent can be

used for economic activities. The use of suitably treated wastewater in irrigation, for instance, effectively augments the primary water supply.

The treatment of water from mining sources is yet another highly attractive option as it could lower the environmental costs of this water, which tends to present a high pollution risk to both the country's rivers and the water table in areas with extensive mining activity.

Preliminary comparisons have indicated that the use of treated effluent is becoming cost effective, and this may well be cheaper than the desalination of seawater. As reuse would happen more than once, the effective increase of the available resource will be considerably more than the portion recycled and the primary resource need only be used to top up the water that is being recycled. The treatment and reuse of such water also reduces the environmental difficulties of disposal.

In inland areas, the return flows from waste water treatment plants flow back into the rivers and are indirectly reused, mostly for irrigation. In the Vaal River system, it is now projected that the increase in effluent from Gauteng (resulting from the growth in urban water use) will soon exceed the quantity required to meet the needs of existing down-stream users. This projection takes into account that some of this water has been earmarked for transfer to the Lephalale area of the Limpopo Province for use at planned power stations and a possible coal-to-liquid fuel plant. In the light of projected shortages of potable water in Gauteng, this surplus effluent should logically be treated back to potable standards for re-use in the Rand Water supply area, rather than released downstream.

Effluent can be treated to different levels (e.g. potable or irrigable) and usage matched to treatment. Its application for industrial purposes is an obvious first option. The use of treated effluent for irrigation rather than fresh water is another possibility. However, to make full use of the opportunity, the bulk of the effluent should be treated to potable standards. While the technology is available to do so (it having first been developed in South Africa and implemented in Windhoek, Namibia), it has not been used on a large scale basis elsewhere in the world. In small towns, effluent treatment to potable standards is not yet considered a viable solution for water scarcity due to sophisticated treatment procedures demanding both technical skill and equipment.

Although the treatment of effluent for re-use falls within municipal jurisdiction, the capacity of local government is limited. Major centres are yet to adopt the treatment of effluent as a favoured option although Ethekwini Metropolitan Municipality is taking the first steps in this direction and will be supported.

The Department seeks to establish the use of recycled water as a key element in the sustainable management of water as a limited resource. Its aim is to encourage the commercial use of this valuable water resource while ensuring the highest environmental standards in land-use and recycled water management.

8.2.5 Desalination

Desalination refers to the treatment of saltwater, a common practice in many parts of the world where coastal cities' water needs are supplied by large-scale desalination plants. With the sea being a practically unlimited source of water, desalination of seawater is a highly desirable option for supplying coastal cities. In recent years, the feasibility of desalination has improved significantly due to technological advancements and the decreases in associated energy use and costs.

Intended use would be productive (industrial and agriculture) although it is possible, especially with technological developments, for desalinated seawater to be treated to a drinking water standard.

The benefits of desalination include proximity to demand, reduced infrastructure costs, reduced water losses, and favourable upgrading and replacement costs. Desalination plants can be operated when needed and can be upscaled with far shorter lead times than dams for example. Due to the availability of packaged plants, this is an efficient method to cater for prolonged drought emergencies, dealing with the impact of climate change and repaid growth scenarios.

In terms of costs, the advancements in desalination technology mean that it can cost anywhere between R5/m3 to R7/m3. The largest component of the cost relates to the energy required to pump water through the membranes as well as the cost of these membranes and their replacement. The cost of water is also

dependent on the recovery rate. Sea water, for example, has a recovery rate of about 50%. There are ways of offsetting these energy costs as demonstrated in the Australian (Perth) desalination project, which has included a household energy savings programme. The desalination plant also buys a significant portion of its energy from wind farms established for this purpose.

The City of Cape Town, Umgeni Water and Ethekwini Metro are in the early stages of investigating the feasibility of desalination. Small towns that have already established small-scale plants include Bushmans River Mouth and Kenton-on-Sea (Albany Water).

While desalinated seawater may be a feasible solution for coastal cities, it is not suitable for inland areas due to the costs of transporting desalinated water over long distances due to the associated use of energy for pumping. For example, the initial cost estimates for the transfer of water from the Crocodile West catchment to the Lephalale area over a distance of about 200km is between R8 to R10/m3. From this fact alone, it can be deduced that it would be prohibitively expensive to desalinate seawater and pump it to inland cities.

8.2.6 Recommendations

While surface water remains the predominant source of water in the current planning horizon, the Department expects surface water to contribute proportionately less accompanied by proportionate growth in the contribution of return flows through treatment of urban effluent and mining waste water, desalination and treated groundwater.

Options for water supply must be considered beyond the traditional river storage options. An assessment of water supply requirements necessitates consideration of all options in terms of managing both demand and supply. Cost analyses need to be undertaken, in terms of both capital and operational expenditure requirements, to establish the costs of infrastructure and distribution to locations of demand. Furthermore, environmental costs need to form part of the evaluation and decision-making process.

Desalination of seawater: Based on the findings of the Reconciliation Strategy for the City of Cape Town, it is recommended that a full feasibility study be undertaken for the desalination of seawater at all the major coastal cities.

Recycling: It is recommended that feasibility studies be performed on the use of treated effluent as a matter of urgency, and that pilot plants be constructed to test implementation.

Building national capacity to harness recycled water as a resource is a priority for the Department. The Department will co-operate and liaise closely with local authorities that have not yet bought into this priority and take the lead with regard to the development of feasibility studies. Once the feasibility and benefits of using treated effluent are demonstrated, implementation will be handed over to local authorities.

Development of surface water resources: New potential surface resources need to be investigated for development well in advance of shortfalls in supply. This investigation will allow for informed comparisons of potential resources for development, as well as informing decision-making in relation to inter-basin transfers. Investigations into new surface resource must take into account the full cost of dams in relation to social impact, such as population displacement, as well as the environmental costs.

Development of groundwater resources: Towns, villages, communities, mines, and other users located in areas with insufficient local surface water and distant from surface water schemes groundwater ought to consider groundwater as a primary resource for their social development and economic growth needs.

Boreholes need to be sited by hydro-geologists to ensure the best yields. To maintain the sustainability of groundwater resources, appropriate yields need to be determined and abstraction rules adhered to. All borehole water levels require monitoring to ensure that abstraction is within sustainable limits. Actual abstraction must be measured and controlled.

In terms of quality, groundwater cannot be assumed to meet drinking standards, and therefore requires constant monitoring. Saline or brackish groundwater can be treated to a potable standard, and this forms an important part of the Department's Reconciliation Strategy for meeting the potable water needs of water

scarce towns. Only if high quality supplies are sustainably provided to people, will groundwater be accepted as a satisfactory source.

Sound management is fundamental to the sustainable and safe use of groundwater, and the requisite expertise must be developed at local government level. The Department will support municipalities in taking responsibility for the sourcing and utilisation of the resource. Guidelines and rules that are in place need to be disseminated and enforced, and this requires regulatory and support capacity.

The maintenance and improvement of the National Groundwater Information Database is central to this effort. The information in this database needs to be reviewed, analysed and reported upon annually, so that it serves as the basis for recommendations at local and national level on the status and use of the resource.

8.3 Supply-side management

This section looks at other supply-side measures that are equally important to the sustainability of water supply and integrity, including water infrastructure asset management, water quality protection and the role of compliance and enforcement in the protection of water resources, both in terms of use and quality.

8.3.1 Water Infrastructure Asset Management

The purpose of asset management is to maximize the value of an asset over its lifecycle. In this case, asset management must ensure that the responsible Water Service Authority derives the most benefit from its investment in infrastructure. This involves constructing, operating, repairing or replacing assets at the optimum time to ensure system reliability at the lowest cost and least impact to the authority. Sound asset management translates into lower tariff increases and improved cost recovery.

The annual expenditure on maintenance and refurbishment of water infrastructure assets is expected to rise significantly over time as the country moves from a capital investment phase of developing new infrastructure to a phase of replacing existing assets and legacy systems. The long-term cost implications for the water sector (or individual authority) of a poorly structured replacement/renewal regime are dramatic and would result in inefficient use of existing water resources.

Comprehensive Asset Management Programs must be developed to ensure that existing water infrastructure is effectively and efficiently managed. The implementation of these programs will need to cater for the demands of an aging water infrastructure, cost increases, and competing demands for limited resources.

8.3.2 Water Quality Management

Water Quality Management (WQM) in South Africa has evolved from simple pollution control to the current integrated approach, which encompasses source, remediation, and resource-directed management. This integrated WQM approach is implemented through a combination of measures and arrangements provided for in the NWA. These provisions incorporate complementary strategies consisting of both resource- and source-directed measures.

Resource Directed Measures: These measures focus on the water resource itself, both in terms of quantity and quality, and take into consideration the character and condition of in-stream and riparian habitats, as well as the characteristics, condition, and distribution of aquatic plants and animals.

Source Directed Controls: These controls contribute to defining the limits and constraints that must be imposed on the use of water resources to achieve the desired level of protection. Water resource management in South Africa links acceptable levels of impact to the concept of resource quality objectives (RQOs) that balance the need to protect water resources with the need to develop and use them. RQOs are defined for specific catchments, based on social, economic, and political drivers for the development and utilisation of these water resources.

Water use and its effects on water quality are regulated through a range of authorizations that are managed either directly by DWAF, or in co-operation with other government departments. It is important to ensure that the limitations and impacts on water resources are amplified throughout all stages of the approval phases.
Pricing strategy also plays an important part in WQM in terms of provisions for waste discharge that

promote sustainable development and efficient use of water resources. The principle underpinning this is that environmental costs must be internalised by those impacting on the environment. Appropriate pricing levels provide financial incentives for industry to reduce waste discharge and use water resources in more optimal ways. Pricing also needs to be set at levels that allow the costs of mitigating the effects of waste discharge on water quality to be recovered.

The Waste Discharge Charge System (WDCS) is thus focused on reducing discharge load in order to achieve or maintain RQOs in a catchment. The Department aims to fast-track the implementation of the WDCS and to establish a funding facility to expedite the construction, operation and maintenance, and rehabilitation of Waste Water Treatment Works, in concert with DPLG and the respective municipalities.

8.3.3 Effecting change in water use behaviour

While the Department spends considerable effort on supply-side measures to secure water availability for the future, this has to be complemented by efforts to conserve water and manage demand through the use of regulations, economic instruments, voluntary measures, and public campaigns. This section provides an overview of interventions to effect change in water use behaviour.

8.3.3.1 Regulations, compliance, monitoring and enforcement

The Department, as the regulator of the water sector, intends to strengthen the enforcement of its regulations. From an institutional perspective, it will enhance and capacitate its compliance, monitoring and enforcement unit, which will ensure enforcement of its regulations and take action against non-compliance and infringements such as illegal abstractions from water resources. It also undertakes to improve the monitoring of both raw and drinking water quality and build on public awareness campaigns such as the Blue Drop and Green Drop initiatives. It will address the current threats to water service and water quality standards by ensuring overall refurbishment and maintenance of water infrastructure in general.

The Department requires the development of co-operative institutional capacity across the water sector to implement a regulatory framework for reducing unlawful water use and levels of pollution in South African rivers, groundwater and estuaries. The success of this framework is contingent on improved monitoring and enforcement of compliance. The Department, therefore, requires adequate financial resourcing to develop a strong Compliance, Monitoring and Enforcement function and to support the investigation and utilisation of technology for these ends.

The Department, furthermore, recommends that an Asset Forfeiture Unit be considered for the possibility of retaining assets seized during action against non-compliant water users.

8.3.3.2 Economic instruments

While water has traditionally been considered an infinite resource, current pressures on water resources suggest the contrary. Excessive withdrawals from catchments for multiple uses have large "unpriced" external effects, including negative impacts on land use and biological degradation as a result of water pollution. In light of the limits to the country's water resources in terms of quantity and quality, the Department needs to consider translating these impacts into the pricing mechanisms that reflect the underlying scarcity value of water.

The Department concurs with the economic view that social welfare is maximized when all costs are reflected in prices, a concept sometimes referred to as "full cost pricing" or the "polluter pays principle". Only when production and consumption decisions take into account all costs to society can an appropriate balance between supply and demand be achieved on the basis of pricing. When prices are artificially low, consumption tends to be excessive.

While it is unlikely that the Department will be able to fully cost all externalities into water charges, it is important to use pricing to encourage consumers to appreciate the true value of water and effect changes in their patterns of consumption.

The Department has **a raw water pricing strategy,** introduced in April 2007, which levies four charges: water resource management; operations and maintenance; depreciation; and
Return of Asset (ROA).
Water prices can be used to encourage customers to use less water and to achieve efficiency gains

that enable water system managers to postpone the need for new capital outlays. The general types of conservation pricing options include the repeal of discounts to industry as an establishment incentive; increased block tariffs; seasonal rates, with higher tariffs during dry seasons and droughts; and excess use charges.

A**pplication to irrigated agriculture:** Resource poor farmers are excluded from the ROA charge in relation to irrigation, which poses a threat to DWAF's ability to recover the cost of supplying water. There is a definite sense that water is too cheaply priced for this sector despite average increases in excess of 20% per annum since the new pricing strategy was introduced.

The Irrigation Development Strategy of the DoA proposes that 600,000 ha of additional irrigation could be developed from water loss savings and improved irrigation efficiency. The sector could be provided with financial incentives to upgrade their irrigation systems to support water conservation. These incentives could be financed by introducing a 1% ROA charge to water used for irrigation, (while all other user sectors pay a ROA of 4%). A further incentive will obviously be the resultant water savings, which could be sold to the state or be traded in areas where water is in surplus. In areas of water scarcity, trade between users sector must be regulated to ensure the best possible socio-economic use of water.

Application to the municipal sector: The application of pricing as a tool to manage demand in a municipal context needs to factor in both affordability and revenue stability. In terms of affordability, municipal level pricing should take into account the characteristics of particular customer classes and their ability to pay higher rates. "Lifeline" rates structures can mitigate undue hardships for low-income customers and should cover the basic volumes of water needed for sanitation.

With respect to revenue stability, the total loss from municipal water reticulation systems for the country in 2005 was approximately 1,150 million/m3, which is equivalent to 28.8% of the approximately 2,000 million/m3 of total municipal system water input at that time. Revenue instability is the most frequently cited obstacle to the adoption of water conservation projects. This is because conservation results in less water being sold; one way of mitigating this loss of revenue is to shift some charges from a volumes base to a fixed charge.

In essence, municipalities must be encouraged to invest in infrastructure maintenance projects that will minimise water losses, any resultant loss in water income could be mitigated by reducing volumetric charges and increasing fixed charges.

In addition to the pricing strategy, the Department has initiated a **waste discharge charge system** (WDCS), aimed at internalising costs associated with waste and to encourage the reduction in waste load, thereby minimising the detrimental impacts on water resources. While the waste discharge charge system allows for full cost recovery, the administration system required to implement it is most likely to prove difficult. In the recent Appeal Court judgment in the Impala WUA matter, it was made clear by the judgment that if charges are not proven, then users do not have to pay until all financial records are clearly explained to clients. A major challenge is the fact that users often complain that charges are not correctly costed and explained. In this regard, there is much work to be done at the regional offices to ensure correct billing and the effective communication of such charges.

8.3.3.3 Self-regulation

Self-regulation can prove to be a highly effective form of behaviour change, especially in a sector such as mining, where major industry players seek to comply with the requirements of the ISO 14000 as part of their efforts to enhance their business practice. The Department will ensure that it supports operations that comply with ISO 14000 standards by providing them with the required regulatory support such as Water Use Authorisations.

8.3.3.4 Public Awareness and Education

Public awareness campaigns on the value and scarcity of water are an essential component to initiatives to conserve water. Over the years, the Department has invested significantly in water awareness campaigns and intends to sustain these campaigns, especially targeting younger children of primary school age. The Department's philosophy is that meaningful change in people's attitudes towards water must be inculcated from a young age in order to reap the benefits of these positive attitudes in the future. However, these campaigns should not be targeted at the younger generations only as it anticipates the conceptualization

and launching of a massive national awareness campaign whose primary purpose will be to instil a sense of appreciation of the value of water among all South Africans. The impact of the campaign should be a change in attitude and behaviour towards water conservation and water use efficiency resulting in the realisation of the WfGD's vision of 'water is life – securing our needs across generations' underpinned by the principle of 'every drop counts'.

8.4 Water Conservation and Water Demand Management

Water Conservation and Water Demand Management (WC/WDM) targets are based on the reconciliation studies and are a national priority that requires commitment and action from all levels of government and water users to avert a water crisis. Immediate action is required, especially in areas already showing stress.

8.4.1 National programme recommendations

Various WCW/DM activities have been initiated at a national level to promote more efficient use of scarce water and energy resources, such as the Memorandum of Understanding with Eskom. These will be pursued in the other water-dependent sectors and will be an important outcome of the consultation process on this framework.

8.4.2 Urban sector

On the basis of the WC/WDM outcomes in the Upper and Middle Vaal River Basin, it has been established that WC/WDM can provide a significant reduction in water demand if measures are implemented and properly maintained on a sustainable basis. Furthermore, the cost of implementing WC/WDM measures is often less than maintenance costs, a fact often overlooked with the result that the WC/WDM interventions fail within a year or two of being implemented. In terms of potential savings, this can range from a maximum optimistic estimate of approximately 400 million m3/annum in the year 2024 to a more conservative and possibly realistic estimate of 200 million m3/annum although it should be noted that savings are extremely limited in some areas where wastage/leakage is low.

8.4.3 Irrigation sector

The causes of water losses in the six irrigation schemes in the Vaal catchment was undertaken as a way of identifying feasible water conservation and demand management initiatives. Most of the conveyance losses in the catchment are attributed to operational losses, which can be easily alleviated.

The potential for water saving by implementing latest technologies has been investigated based on theoretical irrigation application efficiency values. A 2% improvement in each of the six selected schemes would provide a 7.3 million m3/annum saving, which can be reallocated for other uses.

There is currently little incentive for farmers to implement more efficient irrigation systems whilst they are not using their full allocation and are therefore not likely to be motivated by allocation restrictions; however, it is possible to link the water tariff to assurance of supply, as this is likely to provide the kind of incentive to encourage farmers to balance their risks of supply against using more efficient irrigation systems.

8.4.4 Industrial sector

Various industries have reduced their consumption and focused on the management of their effluents, which has contributed to drastic reductions in intake water and the recommendation is that effluent treatment and reuse should be implemented on a much larger scale. Potential measures for water demand management and water conservation for the industrial sector include the retrofitting or eliminating of once-through cooling systems; the proper operation and maintenance of hot water and steam systems and education and awareness programmes

8.4.5 Mining sector

Potential measures for water demand management and water conservation for the mining sector include non-potable use including partially treated effluent; improved efficiency of effluent treatment plants (reverse osmosis); new technology/retrofitting; and the recycling of process and decant water through treatment for supply to other mines/ industrial users as well as municipalities.
Specific actions in relation to water supply areas can be found in Annexure A.

8.5 Climate change

Climate change has become an increasingly important issue in water resource management. Research clearly identifies the resulting risks to the water resources of the country: higher temperatures and more extreme weather resulting in increased rainfall intensity in some parts of the country and longer and extreme drought periods in others. As a result of climate change, the reliability of supply to water users and the levels of risk of supplying users are likely to increase.

To address the potential risks and threats posed by climate change with respect to water security, the following actions should be seriously considered:

- Development of a water sector response strategy comprising of adaptation plans and mitigation measures;
- Stimulate shift in focus from climatic prediction and mitigation to response and adaptation options; and
- Focus on those WMAs or catchments likely to face the greatest risk of water shortages and develop an appropriate and reliable understanding so that risk and disaster management plans can be drawn up and implemented.

8.6 Water for development

To date, South Africa has met and exceeded the timetable for achievement of the Millennium Development Goals in terms of basic water supply and sanitation.

However, based on the current infrastructural capacity as well as the availability of funding and actual water resources, the ability of local government to meet targets set by government in relation to the continuous growth in backlogs faces serious challenges.

8.6.1 An integrated approach to sustainable development

The provision of basic services by key departments needs to take place within an integrated framework to ensure the effective utilisation of government resources. At the same time, issues impacting on infrastructure delivery that are specific to each district and metropolitan area need to be taken into account for interventions to be appropriate.
Notwithstanding the need to accelerate infrastructure delivery, this cannot happen at the expense of long term sustainability. A vision for sustainable human settlements is fundamental to integrated service delivery planning.

8.6.2 Policy implications

Free Basic Water Policy and communities with special needs

The quantity of water made available under the Free Basic Water policy has to be reviewed in the context of special health and hygiene requirements, particularly those of individuals living with HIV/AIDs. Where sustainable, WSAS should give consideration to increasing the basic quantity of water provided free of charge to poor households from 25 litres to 50 litres per person per day. National government will consider increasing the national subsidy over time to make this feasible in all water services authority areas.

Subsidy mechanisms that benefit those most in need and provide for the equitable treatment of large households and multiple households sharing one connection need to be developed. At the same time, sustainability needs to be protected by revenue collection for services rendered over and above a free basic allocation.

Review of the Municipal Infrastructure Grant (MIG) Policy

The current MIG programme is aimed at providing all South Africans with at least a basic level of services, and focuses on covering the capital costs of basic infrastructure for the poor.
For infrastructure development to contribute effectively to economic growth, appropriate financing models are required and MIG policy needs to be revised to support development of infrastructure, including water supply, for small scale economic activities.

8.6.3 Recommendations

Strengthen sector-wide partnerships: The sector-wide approach is fundamental to scaling up service delivery and underlies this strategic framework. The national level facilitates and coordinates policy and sector collaboration, while local or regional agencies are responsible for service delivery. The sector-wide approach provides the vital link between policy objectives and their implementation.

At the core of the sector-wide approach is the development of partnerships across the entire water sector to enhance delivery with the involvement of the private sector.

Co-ordinated planning framework for targets: National targets need to be translated into targets for local government, so that local level development planning to tackle the MDGs can be coupled with national level supporting activities.

Technical support and delivery mechanisms to accelerate infrastructure development: Although municipalities receive extensive capital subsidies from the MIG, many have not spent funds as planned due to a lack of engineering skills and implementation capacity. Existing capacity therefore has to be optimised. To this end, a menu of delivery mechanism options has been developed so that local government can select the most appropriate delivery mechanisms.

Where there is existing technical capacity, DWAF will form partnerships with municipalities to implement projects. Where municipalities have critical capacity constraints due to an absence of technical expertise, with the agreement of all parties involved, DWAF will directly implement programmes or projects. In addition, the use of engineers and other technical skills offered by the private sector should be investigated.

Development of small scale infrastructure to promote rural development: Provinces with large rural populations should consider development of small-scale projects, like rainwater harvesting, that conserve water, address issues of affordability and improve reliability of water services. The building of small communal dams and standalone schemes to support livestock should be an integral part of rural development.

The Role of Women: Women should be thought of as strategic users of water. They manage the use of water for preparing food, for drinking, bathing and washing, for irrigating home gardens and watering livestock. Women know the location, reliability and quality of local water resources. They collect water, store it, and control its use and sanitation. They recycle water, using grey water for washing and irrigation. Their participation in all development programmes should be given priority. Policies and programmatic interventions such as Water Allocation Reform need to factor this in to achieve the desired end result.

8.7 Water for growth

8.7.1 Energy

The economic and social implications of an unreliable supply of energy became apparent in 2008 and necessitated the augmentation of Eskom's current output through the building of additional power stations. This in turn places pressure on the country's water resources given the vast quantities of water required by power stations. The Vaal River Eastern Sub-system Augmentation Pipeline (VRESAP) is currently being built to augment the water supply to the Eskom power stations and Sasol 2 and 3 from the Vaal Dam since the Vaal River system largely meets Eskom and Sasol's water supply requirements and future needs are factored into the Vaal River system reconciliation strategy. Furthermore, a feasibility study is being undertaken to supply water to proposed stations on the Waterberg coalfields, which is likely to see treated effluent emanating from northern urban and industrial areas of Gauteng supplying the Lephalale area. The same applies to the extension of Sasol's operations with regards to the development of additional coal-to-liquid plants.

In terms of water efficiency, Eskom is investing in dry-cooled systems although this means increased operational costs. Eskom is also strongly encouraged to investigate the possibility of upscaling the Fluidised Bed Combustion technology used in small plants to the large boilers used in large power stations. In the event that coal-fired power stations are built on the Waterberg coalfields, Eskom will be obliged to intensify its water efficiency as an adequate supply of water is a concern.

An alternative to coal-fired stations is renewable energy and in particular, hydropower stations.

Unfortunately, South Africa does not have adequate water supplies to meet the needs of large conventional hydropower stations although in a few instance small hydropower generators are a possibility. The determining factor is the option for conjunctive use with irrigation or other storage releases. There is one proposal on the table which is for the Department to supply water from the De Hoop Dam for the operation of Eskom's proposed hydropower pumped storage scheme in the proximity of the De Hoop Dam, near Steelpoort and Roossenekal in the Limpopo Province. Furthermore, the Department is negotiating with Eskom to pump water 700 m high from the Steelpoort River valley to the top of the Nebo Plateau at a reduced energy cost for the benefit of communities in the Nebo area.

Given the pronounced link between energy and fuel supplies and water availability, the Department is closely considering and factoring in the water needs of the energy sector in its reconciliation strategies and accompanying feasibility studies. In so doing, concepts and principles that underpin this planning include that of water efficiency, conjunctive uses of water, linkages between water for growth and water for development, and the utilization of alternative sources of energy. There is a close working relationship with the large water users in the energy sector to ensure that current expansion plans for the national energy grid is supported by water resource planning initiatives.

8.7.2 Mining

Considerable scope exists in the mining sector for improved water demand management and water conservation. The industry can make more extensive use of partially treated effluent in industrial processes. New technologies such as reverse osmosis wastewater treatment and retrofitting of old technology should result in more efficient and cleaner use of water. In particular, water polluted by acid mine drainage should be treated and recycled in mining processes, or sold to municipalities and other industrial users.

In terms of small scale miners, the Department would like to see the provision of greater support directed to them so that the long term environmental damage does not outweigh their collective benefit.

8.7.3 Industrial

Most bulk industrial use is discussed either as urban use (to follow) or, in the case of the Sasol CTL plants, as an energy use. There are a few bulk industrial users falling outside these areas or categories such as pulp mills, Petro SA near Mossel Bay, and proposed ethanol plants. DWAF should be informed of all new activities requiring water long before firm plans are made to start with any development.

8.7.4 Urban

Urban use is here defined to include both domestic use and industrial use within the urban areas, which ranges from the large metropolitan areas to small towns. Large industries that abstract directly from the water resource, such as Eskom and Sasol, are considered "standalone" and are dealt with separately.

Economic activity in South Africa is concentrated in urban areas, particularly the large metros account. The growth of urban areas is strongly linked to economic development. Water does not drive growth, but the lack of water can severely limit it, with severe consequences for both people and the economy.

The urban sector is expected to pay the full cost of water, except for a basic needs allocation that government may provide through grants. In centres that are distant from exploitable water sources, costs are likely to be high and will constrain growth. In water-scarce areas, the adoption of services such as dry sanitation may be required if sustainability, affordability and suitable levels of economic growth are to be achieved. In some Northern Cape towns, for example, there is not enough water to provide for both water borne sewerage, and to serve the mines upon which the local economies are dependent.

The recommendations in the Reconciliation Strategies for the four large metropolitan areas must now be implemented if the Department is to assure sufficient water supplies for domestic and industrial uses.

It is recommended that water be supplied to all urban areas to ensure that all reasonable requirements are met, based on Reconciliation strategies that will be developed for the remaining urban centres. The focus is on ensuring that growth points, as identified in the National Spatial Development Perspective, are supplied the water they require. In all cases, WC/WDM will have to be implemented, while all possible supply side options will be investigated and recommendations made for each area.

8.7.5 Irrigated agriculture

The Department wishes to see several improvements with regards to the use of water by irrigated agriculture. Firstly, the improvement of water management through water supply management and irrigation management to effect water use efficiency is required. The Department anticipates demand-based supply systems whereby adequate supplies of irrigation water are available when and when lawful irrigation farmers need it. Adequacy of supply is particularly important during the peak water requirement period of the crop season whilst assurance of supply is critical during growth stages during which crops are sensitive to water stress. Secondly, the enhanced use of 70,000 hectares of underutilised irrigable land, which is situated within government schemes and which have received water allocations. Thirdly, the Department wishes to see the revival of food plots within the former homeland irrigation schemes, as these are believed to be vital for community and household food security. Related to this is food production in home gardens and the Department plans to support this form of miniature irrigation and the allocation and provision of water for this purpose. Fourthly, to ensure the sustainability and proper management of irrigation development, the Department recommends that the Department of Agriculture, as the lead department, develop guidelines on all aspects of irrigation planning, development and management.

Recommendations for commercial irrigation operations: Commercial irrigation must be scheduled to ensure only the required amount of water is used and at efficient timings, and involves continuous measuring of water applications. This must be enforced, and complied with. The following actions are recommended: the enforcement of irrigation scheduling; prohibition of the unlawful use of water for irrigation; measurement of the quantity of water applied at given times; preparation of a water use efficiency and risk management plan; and the gradual reduction of the quantity of water used for irrigation through appropriate technology.

Recommendations for water management agencies: the identification of all areas that used to have irrigation farming and support provincial Departments of Agriculture in the re-establishment of irrigated crop production on these areas; and the use of conditional funding allocation to give priority to areas that used to produce high value crops, and have the capacity to do so on a sustainable basis.

Recommendations for household and community level irrigation: the promotion of the revitalisation and inclusion of the food plot components of homeland irrigation schemes; the promotion of the provision of water for home garden food production in rural town and villages and in peri-urban areas; the promotion of rooftop and field runoff water harvesting and storage; and the promotion of efficient water saving irrigation technologies, such as clay pot irrigation.

Recommendations for use of groundwater in irrigation: the exploration of the further use of groundwater for small-scale irrigation; the development of groundwater for household and community level food plots; and the promotion of groundwater resource usage among isolated communities.

Given that improved water use efficiency may not be realised immediately, there is a need for the Department to regulate water use in this sector through the introduction of a cascading water tariff for irrigation, where by 50% of the predetermined water quota is supplied at a fixed tariff, after which the water tariff rises with consumption (80%) up to the limit of the quota, and is calculated according to the total quantity used.

8.7.6 Environment and natural resource management

The real value of aquatic ecosystems, and ecosystems that affect water availability, must be recognized and given weight in water management decisions. A balance must be achieved between water as a necessary input to promote economic growth, create jobs and eradicate poverty, its role in maintaining the functioning and resilience of ecosystems, and its importance in enhancing social welfare, both now, and in the future.

The introduction of the concept of an environmental Reserve in the NWA has had a very strong positive impact on all river systems, by putting the brakes on unbridled development. It is, however, proving extremely challenging to meet environmental needs where catchments are already fully developed. This requires reclaiming water from existing water users, who are increasingly urban and industrial users, through compulsory licensing, in order to improve environmental standards that have long been degraded.

South Africa has few major rivers that have not been developed (the Mzimvubu and the Mkomazi are the biggest), but many smaller systems, especially coastal rivers, that are ecologically 'pristine'. Every effort should be made to apply standards required by the ecological Reserve to these rivers. Some development would certainly be possible in the Mzimvubu, including forestry and smaller scale irrigation schemes, which happens to be all that the terrain allows. Partially developed rivers (Olifants, Mkuze, others) have seen some

degradation and any further development should be undertaken with discretion. Fully developed rivers such as the Vaal, Mgeni and Crocodile East are today no more than 'workhorse rivers' and should be managed as such.

Natural resource management is essential for water for growth and development. The natural resource management programmes – Working for Water, Working for Wetlands, Working on Fire, Working for Woodlands and Working for Energy – are key components of the management of water quantity and quality in South Africa, and pivotal to the success of Water for Growth and Development. Next to demand-side management, they offer the best returns on investment for water management – but with the added benefits of multiple benefits for biodiversity, energy, land-use practices, employment opportunities, fire management and other benefits. It is essential that co-operative governance ensures the optimal returns on investment from these interventions, and makes use of legislation, incentives, disincentives, advocacy and research to support this.

8.7.7 Forestry and Small-Scale Enterprises

Afforestation was declared a Stream Flow Reduction Activity (SFRA) under the NWA due to its impact on the flow of rainwater into streams. However as a direct user of rainfall rather than water resource infrastructure, forestry is an efficient water resource user.

Although the industry estimates that another 760,000ha of forestry is required to keep the country self-sufficient, the consensus is that water resources can only accommodate somewhere between 100,000 and 200,000 additional hectares. Allocation of water for afforestation should receive priority in areas where water is still available for this purpose (almost exclusively on communal land).

A key recommendation is that the state should consider funding small dams, or encouraging the forestry industry to do so and to allow dry season releases to compensate for forestry's effect on river flows. This would make it possible to sustainably achieve the target 100 000 ha of new afforestation in the Eastern Cape over the next 10 years.

Where further surface resource development is required to make water available for allocation, two main rules should apply. Firstly, if water is intended for urban and rural household supply, now or in the future, forestry users must pay the full cost for that water. Secondly, any surplus water should be allocated to use that produces the largest social and economic benefit at the least cost. The forestry industry is a strong contender in high rainfall areas and should be given opportunities to apply for licences.

8.8 Acid Mine Drainage

It is recommended that the Department consider issuing a directive to mines requiring an action plan for the immediate construction of mid-shaft plugs and pump stations. Not only will the construction of this be expensive, but the monthly maintenance costs will run into millions of rands, and it is not a sustainable long-term solution.

By far the most attractive solution is for AMD to be converted to potable water and sold to Rand Water. International Capital has been secured for a 75 mega litre treatment plant as Phase 1 of such a project on the basis of a pre-feasibility study undertaken by the Western Utilities Corporation (WUC) that included pilot plants demonstrating the required technologies. If the regulatory processes can be streamlined, the project could be completed by December 2010. In as much as the Department contributes to the regulatory framework, this would appear to be a priority.

The problem of AMD cuts across government departments, and the unfolding crisis on the Witwatersrand has lead to the creation of a cross-sectoral Government Task Team drawing from DWAF, DME, and DEAT. The Government Task Team has succeeded in establishing Working Groups for each of the four basins in the Witwatersrand. Since the problem of AMD is not restricted to the Witwatersrand, it makes sense to apply the skills and experience gained through responding to this crisis to other instances where AMD poses a current or future threat.

8.9 Water governance and co-operative planning

8.9.1 Water governance

A primary thrust of the WfGD framework is to emphasise the life-sustaining importance of water as a scarce resource in South Africa and to focus attention on the fact that, unless the continuous judicious use and effective management of our water resources is taken on board by every stakeholder, water availability threatens to become a constraint on growth and development. Our water management policies and legislation provide for participative water governance and a spectrum of water management and water services institutions is envisaged for the delegation of powers and responsibilities to relevant levels.

Although many of these institutions have already been established, the processes for establishing these institutions and instigating shared water management in conjunction with them are complex. DWAF has embarked on a process of institutional and organisational re-alignment. The success of the WfGD framework is largely dependent on the establishment and commissioning of a resolute institutional framework for water management, with clear roles and responsibilities, both in terms of water resource management and water services. It is imperative that the components of this framework be capacitated to fulfil expectations with regard to their roles and responsibilities.
Reporting on, and accountability for, the various roles that institutions play as a part of the water value chain forms a critical part of the oversight and regulatory environment that will be created. The DWAF has already initiated a programme that will create the required regulatory framework. It will be essential that institutions enhance their co-operation to effect redress, minimize duplications, and maximize efficiencies. The sector will have to work together to ensure that these institutions have the required capacity to deliver upon their mandates.

8.9.2 Co-operative planning

Co-operative planning in the water sector: Within the water sector, the WfGD framework is aiming to ensure better interaction between planning initiatives around water resource management and water services, thereby progressing South African water management towards integrated water resource management. The roles and responsibilities for the spectrum of role-players in water resource management and water services need to be more clearly defined. An example is the development of firm roles and responsibilities for water services authorities with regard to water sources within their areas of jurisdiction.

At the inter-sectoral level, DWAF has aligned its planning initiatives with broader governmental thrusts since the establishment of the 1st editions NWRS during 2005. At the national level, the Department has focused its reconciliation studies on the 26 priority growth nodes as contained in the latest NSDP. As discussed in this document, these studies have revealed serious escalation of water resource management problems in respect to the four largest metropoles. The solution for these problems comprises a balanced package of demand and supply management initiatives that need to be jointly planned and implemented by institutions from the various spheres of government.

DWAF also has programmes aligned to specific national initiatives such as poverty relief. The Water Allocation Reform (WAR) programme is an example. There are challenges with the planning and roll-out of aspects of WAR, especially in relation to establishing emerging farmers. What is required is a process/forum from where projects such as this can be jointly planned and implemented in conjunction with other crucial role-players such as the Departments of Agriculture and Land Affairs.

Similarly, there are various departmental structure that are working to forge closer planning and implementation relationships with provincial and local spheres of government, especially with regard to their Provincial Growth and Development Plans and Integrated Development Plans respectively.
Co-operative planning in other sectors/departments: There is a distinct need for institutions beyond the water sector to take due cognisance of constraints originating from the country's scarce water resources in planning and development decisions. To make this possible, the Department strives to re-package the concepts and information regarding water management in a more user-friendly way to simplify its use and understanding.

9 High level recommendations

9.1 Mainstreaming water

It is the Department's intention to ensure that water is placed at the heart of all planning decisions in the country to ensure that any decisions taken that rely on a steady supply of water, both in quantitative and

qualitative terms, adequately factor in water availability. Water can only support growth and development in the country without compromising the ecological sustainability of the resource if it is at the nucleus of planning and decision-making in all sectors.

9.2 Diversifying the water mix

Water availability is currently based on surface water (77%), return flows (14%) and groundwater (9%). Reconciliation studies undertaken in major urban centres have revealed that in addition to these sources, desalination and effluent re-use ought to be considered given the high risk of water shortages. Desalination refers to the treatment of saltwater and effluent re-use refers to the treatment of urban and mining effluent. Both are a potential major source of water for coastal cities and treated effluent for major inland systems. In the long term, surface water will remain the predominant source of water but the Department expects a reduction on the dependence on this source accompanied by the increased use of groundwater and a significant increase in return flows through the treatment of urban and mining effluent. The mix at the local level will be dependent on the most affordable and appropriate source depending on water use; for example, desalination of seawater for productive uses in coastal locations is considered highly feasible provided that it is not transported inland – similarly, inland water resources should be retained for use inland.

9.3 Promoting Water Conservation and Water Demand Management

The reality is that as a country we can no longer afford water losses and therefore it is imperative that the focus on water conservation and water demand management must be strengthened, especially as there is a greater return on investment through water loss control and water use efficiency. The Department will prioritise the establishment of the water demand funding facilitation unit to provide support to municipalities in their effort to introduce water conservation and demand management.

9.4 Promoting and maintaining water quality

The Department is extremely concerned about the status of the quality of the country's water resources. It has undertaken to strengthen its compliance enforcement and monitoring as way of clamping down on water use behaviours that have a detrimental impact on our water resources. It has also identified that a key challenge to sustained and healthy water supplies is the poor maintenance of waste water treatment works (WWTW) and the Department will work closely with the Department of Provincial and Local Government to restructure the Municipal Infrastructure Grant (MIG) so that it is used for the purposes of WWTW rehabilitation and construction. Lastly, the Department wishes to see rapid and effective action taken to address the threat the acid mine drainage poses to the immediate and long-term integrity of our water quality.

9.5 Water for Development: Addressing service backlogs

The Department has reached the targets of the MDGs in terms of the halving of water and sanitation backlogs in 2005 and 2008 respectively. However, too many South Africans still do not have access to basic water and sanitation services and it therefore wishes to achieve the target of full access to basic water and sanitation services for all by 2014. It is the Department's recommendation that the service backlogs are prioritised and addressed through a combination of short-term interventions such as rainwater harvesting and the further exploitation of groundwater sources. Ultimately, a balance needs to be struck between large and small-scale infrastructure projects. Where a community can be serviced by existing large-scale infrastructure, this should happen with immediate effect as the Department strives to achieve universal access to water and sanitation services. Where a community cannot be serviced by a large-scale infrastructure project due to the cost of such an intervention (for example, pumping water to mountain-top communities at higher altitudes), then small-scale schemes must be planned and implemented. Where large-scale infrastructure could solve local water scarcity, such as the De Hoop Dam, the necessary planning and resourcing must be undertaken and interim measures introduced to compensate for the long lead-times. The Department should also prioritise schemes in areas with resource development potential that coincide with areas with high service backlogs. It will also support sector plans where water use for growth

purposes can simultaneously support water use for development purposes. The Department will seek out and support interventions that support the dual goals of water for growth and development as one goal should not be at the expense of the other.

9.6 Water for Growth: Changing water use behaviour for the future

The Department is very mindful of water use behaviour that impacts negatively on the resource both quantitatively and qualitatively. It is currently exploring a potential mix of mechanisms to change this behaviour, which include regulatory instruments, market-based instruments, self-regulation, and awareness and education, and it will match appropriate mechanisms to mitigate offending behaviour. Currently, there are two sets of behaviours that it is very concerned about and which it wishes to address as a matter of urgency. The first is the unlawful and damaging extraction from and pollution of the Vaal River system by commercial users. The second is the extent of water use inefficiencies among commercial irrigation agriculture.

Commercial irrigation agriculture receives approximately three-fifths of allocated water and to date has been exempted from certain water charges. It is the Department's view that this sector needs to make a contribution to the operations and maintenance of state-owned irrigation infrastructure as particular consumptive behaviours in the sector suggest that water may be too cheaply priced. The Department is also considering other interventions including water allocation reform, water trading and the promotion of techniques to enhance water use efficiency by this sector.

9.7 Nurturing attitudinal and behavioural changes towards the value of water

The Department over the years has invested significantly in water awareness campaigns and intends to sustain these campaigns, especially targeting younger children of primary school age. The Department's philosophy is that meaningful change in people's attitudes towards water must be inculcated from a young age in order to reap the benefits of these positive attitudes in the future. However, these campaigns should not be targeted at the younger generations only and for this reason it anticipates the concepualisation and launching of a massive national awareness campaign whose primary purpose will be to instil a sense of appreciation of the value of water among all South Africans. The impact of the campaign should be a change in attitude and behaviour towards water conservation and water use efficiency resulting in the realisation of the WfGD's vision of 'water is life – securing our needs across generations' underpinned by the principle of 'every drop counts'.

Endnote: Explanatory note on Figure 9: Average incremental cost of intervention measures

It is important to note that developing a national marginal cost of different intervention measures can be misleading, since the marginal cost of different options are dependent on a number aspects for each option, namely:

- In the case of water losses, the level of water losses for the different sectors and the potential to implement water loss control measures determines the marginal cost of implementing water losses. Where a sector is close to the Economic Level of Leakage (ELL), the marginal cost of implementing the measure increases substantially.
- In the case of inter-basin transfers, depending on where the transfers are sourced from, the dam sites and the environmental considerations of different sites, as well as the timing of the augmentation scheme (time value of money), the marginal cost of transfers can vary substantially. The economy of scale of the transfer schemes also affects the unit cost of additional water supplies.
- The desalination measure is based on desalinating seawater, and supplying coastal towns. However, the economy of scale (size of the desalination plant) of the plant can impact on the unit cost of desalination.
- The unit cost of reuse of domestic effluent is likely to differ from reuse of industrial effluent due to the quality of the effluent before treatment.

Therefore, the figures should therefore not be understood as the actual marginal cost of the intervention but will vary on a project-by-project basis and will depend on the probability that exists for each of the water supply intervention options. The general trend is that where WC/WDM exists, it provides the least cost per unit of water compared to all other options.

10 Annexure 1: Recommendations on WC/WDM in relation to specific water supply systems

10.1.1 Western Cape water supply system

The WC/WDM strategies came about following the potential savings findings of the reconciliation strategy for City of Cape Town:

- **Pressure Management** (PM): A realistic predicted saving of 17 million cubic meters per annum through pressure management has been identified.
- **Leakage Repair:** The implementation of leakage repair as an option should be actively promoted
- **Elimination of Automatic Flushing Urinals** (AFU): Several options are available for replacement/retrofitting of AFU, which could amount to an estimated potential water saving of 4.3 Mm3/a.
- **Introduction of Water Efficient Fittings:** Retrofitting with water inefficient fittings with more efficient ones in private households, commercial, institutional and industrial buildings was identified as having a realistic total annual saving of 10.2 Mm3.
- **Tariffs:** Correctly structured increased rising block water tariffs can play a major role in moderating water demand.
- **Metering:** Universal metering is essential in order to restrict and control consumption as well as to ensure an equitable distribution of the costs involved in providing supply.
- **User Education:** The potential annual savings attributed to user education may result in an annual saving of 20 million cubic meters predominantly by eliminating the wasteful use of water and promoting waterwise gardening.
- **Promotion of Private Boreholes**: A quick, low cost, socially acceptable solution, but has a low yield and environmental implications.
- **Promotion of Grey Water Use:** Is also a quick, low cost solution, but is not likely to be socially acceptable and may have health as well as environmental implications.

10.1.2 Mokolo River catchment

Whilst the water use and availability in the Mokolo River catchment is currently in balance, the available water supplies will not be able to meet the increasing future demands due to economic growth in the catchment. The additional 3 Ml/d can be provided from augmenting the water supplies.

Irrigation Sector: The total water use by irrigation was estimated to be 59 million m3 per annum, which gives a specific water use of 6 740 m3 per hectare per annum. The effective irrigation efficiency for the Mokolo River Catchment was calculated to be 71%.

Most areas do not have good data sources for water losses that affect efficiency, however conveyance efficiencies for the area downstream of Mokolo Dam range from 30 to 45%. If this could be increased to 70-90% potential water savings of close between 6 million and 10 million m3 per annum become possible.

Industry, mining and power-generation Sector: Currently the power station abstracts approximately 3.465 million m3 per annum from Mokolo Dam, which accounts for 49%of Eskom's allocation of 7.1 million m3 per annum. There is unaccounted for water (UAW) of 447 111 m3, which includes both apparent losses due to meter calibration errors as well as real physical losses.

The total potential water savings at Matimba Power Station can amount to approximately 3.3 Ml/d or 1.2 million m3 per annum if the following WCWDM recommendations are implemented:

- Carry out a comprehensive performance assessment (CPE) of the water treatment plant.
- Undertake testing of the water meters in the power station and calibrate them to ensure accurate meter reading for improved water balance assessment.
- Undertake comprehensive leak identification, detection, and leak repair programme of the power station water infrastructure.
- Review the potential for blowdown optimisation through the process of ozonation.

Domestic Sector: The situation assessment identified that there is potential for water loss control by implementing active leakage control and rehabilitation of the existing infrastructure the apparent losses were estimated to be 5%. The potential savings from implementing water conservation and water demand management measures amount to approximately 1.822 Ml/d. An additional 2.164 Ml/d savings can be realized through implementing consumer use reduction measures.

10.1.3 Umvoti-Umzimkhulu catchment

Water resources in the Umvoti–Umzimkhulu WMA are stressed owing to an over-allocation of water from some water resources. The current scarcity of water provides a challenge to growth. There is a water deficit by 132 million m3/a, the WMA comprises of 30-40% water losses

The potential savings within the Umvoti–Umzimkhulu, if the WC/WDM measures are implemented per sector, are as follows bearing in mind that there are no figures for industry:

- Water losses in irrigation are estimated at 30-40 % and assessments indicate potential savings of up to 30%.
- Water losses for domestic are estimated at 22% with an opportunity to realize 5% savings.

Responsibility and accountability to account for water losses, inefficient and ineffective use as well as wastage of water, in all municipalities and all large water users such as agriculture, industry, mining and power generation is the most important requirement.

10.1.4 Management options for WC/WDM

Specific Recommendations for Agriculture:

- Balancing weirs.
- Removal of alien vegetation.
- Irrigation pipelining.
- Irrigation scheduling.
- Irrigation pricing –volumetric based.

Specific Recommendations for the Mokolo River catchment:

- A meter renewal program be developed in order to reduce meter reading areas.
- General improvement of assets and operational records.
- Field work is required to confirm the information recorded in an Asset Management Plan.
- Available drawings of primary system components such as pumping stations and services reservoir are stored in a central repository.
- Consumer use reduction: There should be a steep rising tariff aimed at achieving reduction in consumer use accompanied by education and awareness programmes.
- Review By-Laws: The water by-laws of each of the towns comprising Lephalale need to be reviewed and revised into a uniform version that reflects the fundamentals of WC/WDM and how it can be enforced.
- Consumer use specific measures: A number of water use audits on representative households, schools and other non domestic users should be undertaken.
- The construction of a hydraulic model of the distribution network is required to determine whether the positions and specifications of the existing PRVs are correct.

- Based on the calibrated hydraulic model, it is recommended that the full system metering required and the establishment of zones and district meter areas is implemented for ease of monitoring the reticulation network to facilitate leakage identification and repair.
- Consumer demand management and that active leakage control is reviewed once the network has been correctly sectorised.
- The increase in abstraction from the bulk purchase of water from Kumba Resources should be deferred for the time being.
- Current data indicates that pressure management does not seem to offer sufficient water savings to be financially viable. A review of the position and size of the existing pressure reducing valves (PRVs) is proposed, with a view to installing time modulated controllers to reduce pressure to 2 bars at night.
- Implementation of an active leakage control programme which comprises establishment of zones and/or DMAs, leak location and repair offers some savings to be financially viable in Marapong.

Specific recommendations for the Umvoti-Umzimkhulu catchment:

- Development of a standardized water balance.
- Identifying the extent of pressurized water supply to customers and strategies in place for pressure management.
- Efficient leakage reporting system and assessment of active leakage control.
- Monitoring of consumer meter readings (Residential/Commercial/Industrial).
- Infrastructure maintenance planning (Emergency/Routine) and investigation of asset register.
- Sectorisation of reticulation system in place.
- Efficient bulk and zone management metering systems in place.
- As built drawings of all bulk and reticulation infrastructure.
- Awareness and education programmes (Schools/Communities/other media).
- Informative/Itemised billing.

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