National Water Resource Strategy

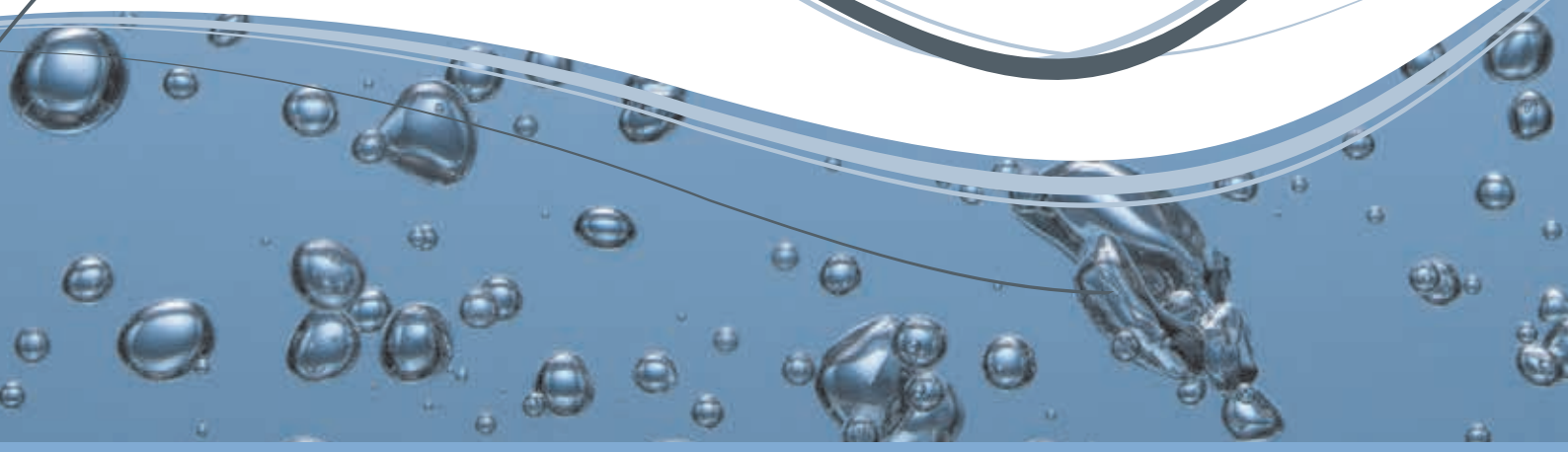
Water for an Equitable and Sustainable Future

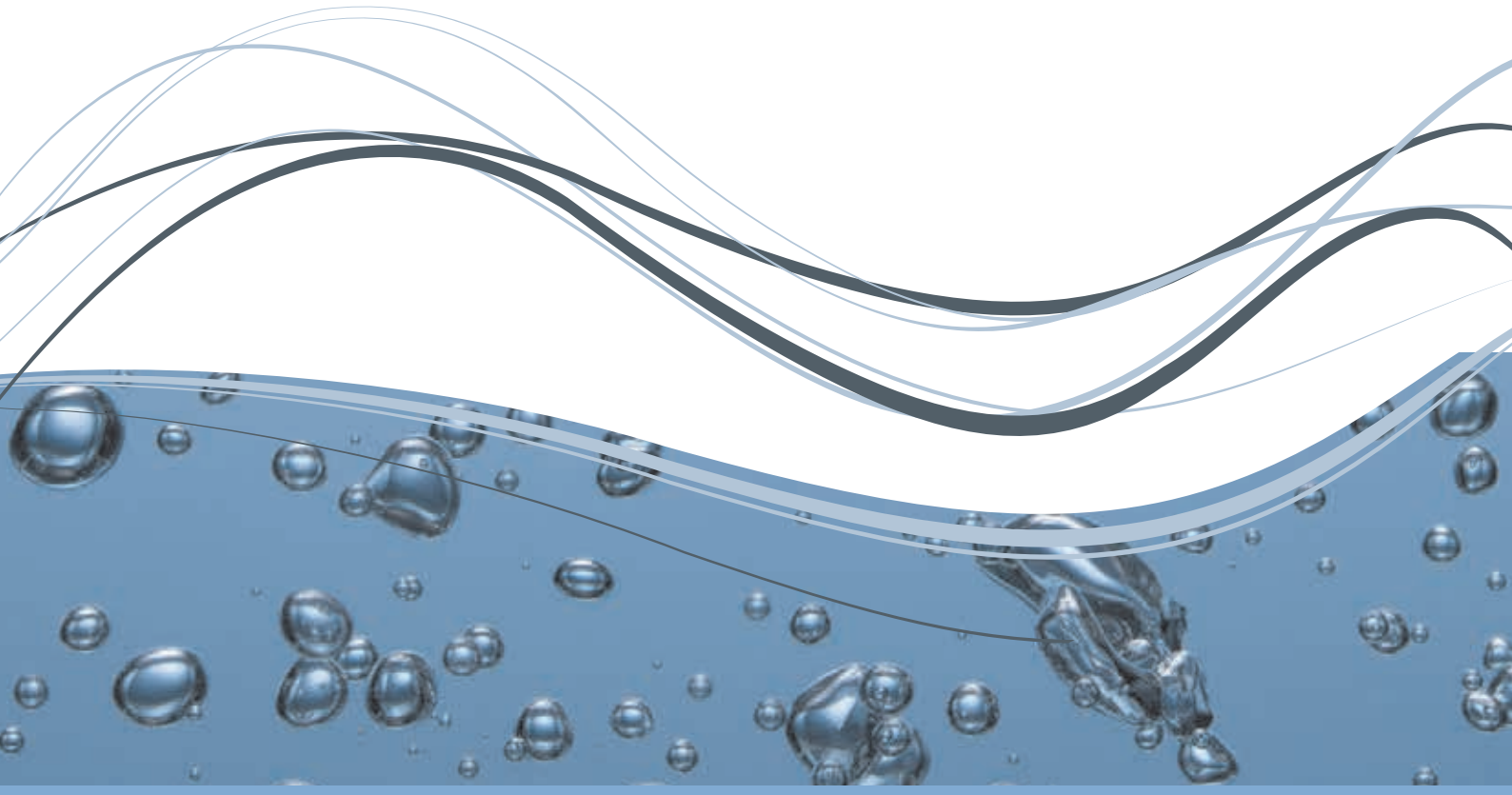
June
2013
Second
Edtion

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

VISION OF THE NWRS2

Sustainable, equitable and secure water for a better life and environment for all





NWRS

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National Water Resource Strategy

PREFACE

We all want a better life for all.

This is the decade of equity and redistribution – the decade we must realise everyone's right to water, a right guaranteed in our Constitution.

How do we achieve equity and redistribution of our water resources? How do we ensure water security for the future and also enough water for our national economic growth and development priorities? These are the challenges this National Water Resource Strategy 2 tackles. Our water resources are under pressure. If we are to meet the demands of the economy, of society and ensure sufficient water for the environment we need to make strategic decisions and plan comprehensively and carefully. This NWRS2 sets out the strategy to plan, develop, manage, protect and control the use of our water resources effectively for the future.

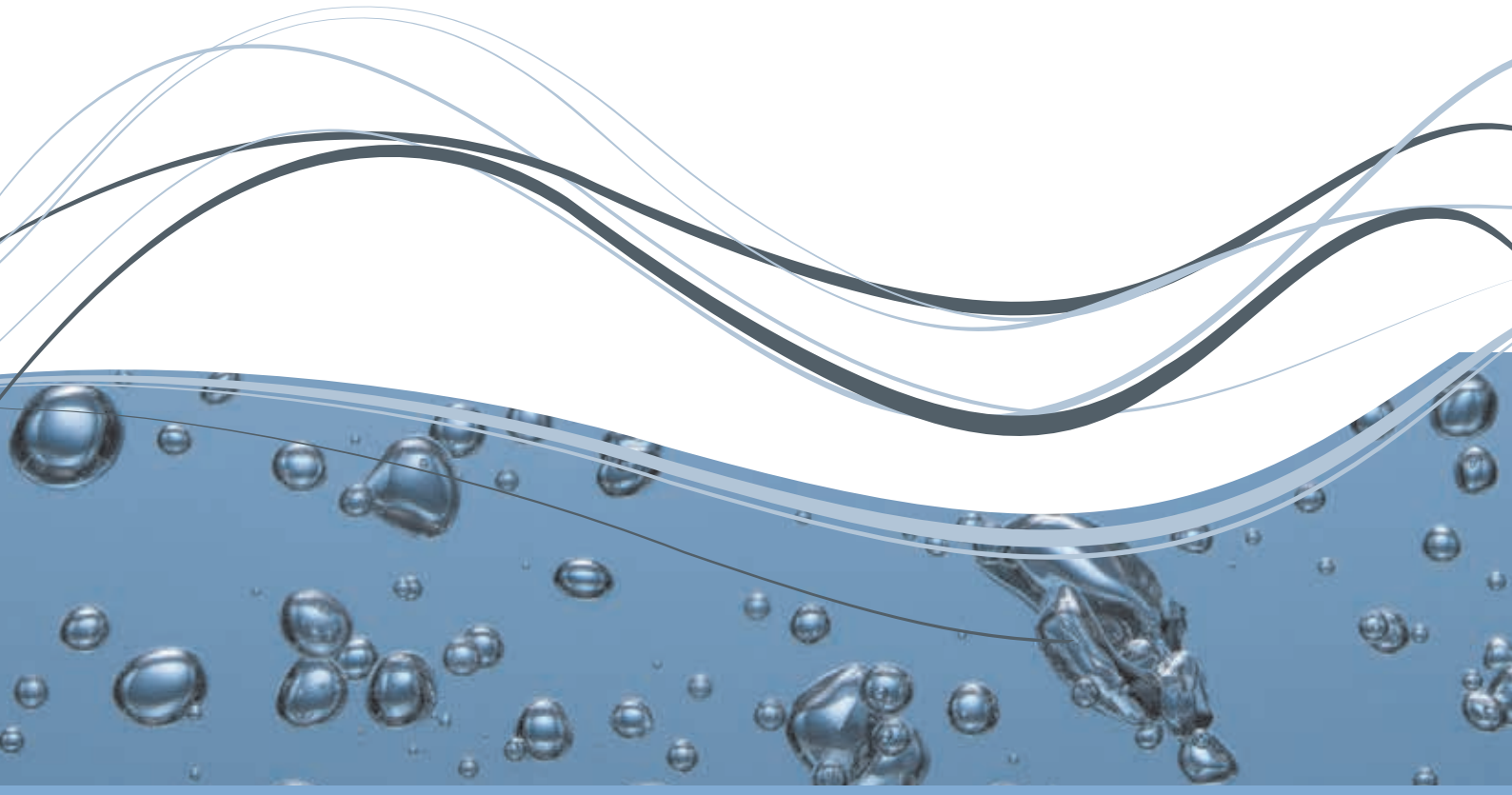
If we are serious about achieving equity and redistribution and the goals of our developmental state, we need to streamline our policies, legislation and strategies for both water resource management and water services. We are currently tightening our policy, legislative and overall sector environment and this Strategy forms part of that process, so we can remove obstacles to greater equity in water resource allocation and meet our national objectives.

The dynamics of water, equity, development and growth are complex where water resource management lies at the heart of our aspiration to achieve growth, sustainable development and poverty reduction. There can be no growth and development without water, so water must be at the heart of all our planning, financing and governance frameworks.
Good governance, improved management of our resources and ensuring that every drop counts are addressed in the strategy, through an improved institutional framework, strengthening our sector capacity, and through various mechanisms and concepts, such as water re-use and water off-setting.

Towards addressing our infrastructure challenges and demands for the entire water value chain, we need an estimated R670 billion over the next ten years. In addition we require an investment of R30 billion for sustainable water management programmes, bringing our total sector investment to R700 billion, being R70 billion per year. This is a considerable investment which will be funded from on-budget and off-budget sources through the private sector.

I would like to acknowledge and thank all those who contributed to this Strategy which, I believe, provides a robust way forward towards achieving water security, sustainability and our national priorities. Making this strategy work requires a collaborative effort. I call on the entire water sector and other sectors, both public and private, to embrace this Strategy towards realising a better life for all.

MRS B E E MOLEWA
MINISTER OF WATER AND ENVIRONMENTAL AFFAIRS



NWRS

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National Water Resource Strategy

FOREWORD

This National Water Resource Strategy 2 sets out how we will achieve the following core objectives:

- water supports development and the elimination of poverty and inequality
- water contributes to the economy and job creation, and
- water is protected, used, developed, conserved, managed and controlled sustainably and equitably.

The major focus of the NWRS2 is equitable and sustainable access and use of water by all South Africans while sustaining our water resource. Equity and redistribution will be achieved through the authorisation process and other mechanisms and programmes, such as water allocation reform, financial support to emerging farmers and support to urban and rural local economic development initiatives.

With our growing population, and focus on economic growth and development we need to ensure water security and healthy water ecosystems that support our national imperatives. Apart from the water demands of the economic sectors (energy, mining and agriculture), increasing urbanisation and industrialisation place enormous pressure on our scarce water resource in terms of management and allocation. Over the last ten years water consumption of the domestic sector has increased from 22% to 27% of the total resource.

Whilst we have well-developed water resources infrastructure (with more than 4 395 registered dams) we are fast approaching full utilisation of available surface water yields, and are running out of suitable sites for new dams. In addition, climate change outcomes in terms of rainfall and temperature will have a negative impact on water storage. Water demand is likely to grow at about 1.2% over the next ten years. We therefore need to find new ways of reducing water demand and increasing availability – which move beyond 'traditional engineering solutions' of infrastructure development. Ensuring a sustainable water balance requires a multitude of strategies, including water conservation and water demand management (WCWDM), further utilisation of groundwater, desalination, water re-use, rain water harvesting and treated acid mine drainage.

Whilst South Africa benefited from a surplus of water available in 2000, the time has now come where a mix of water resources is required to reconcile supply and demand. Towards this end, Reconciliation Strategies have been developed to assess water balance against future needs. These strategies will inform our future water resource planning, management and investment and key issues include:

- greater focus on WCWDM – every drop counts and we cannot afford to waste any more water, anywhere
- increased value and utilisation of ground water
- re-use of waste waterat the coast as well as in inland systems
- opportunity for more dams (though limited) and transfer schemes (and where the opportunity exists, it is at great cost)
- desalination:
  - Small scale seawater desalination already being used in certain areas
  - Treated mine water desalination becoming more important
  - Desalination of seawater on a large scale
- catchment rehabilitation, clearing of invasive alien plants and rainwater harvesting is growing in importance
- making more water available in the future, but at sharply rising costs.

Given constraints and demands on the resource, we cannot afford practices which reduce supply, such as pollution, inefficient water management practices, lack of infrastructure maintenance, unaccounted for water, and poor governance. Our national economic and development priorities together with the complex environment within which we operate require a “new” era of advanced and smarter water management. This Strategy provides for robust and sustainable water sector institutions (including nine catchment management agencies and nine regional water utilities) that have the necessary capacity to manage our water resource sustainably and equitably as well as ensure sustainable and effective service delivery.

The concepts, approaches and themes spelt out in this strategy are in line with international principles and approaches (World Water Forum and Rio+20 Summit) where social and economic goals are aligned, sector investment is increased and water is recognized as fulfilling a central role in socio-economic planning and development.

A key challenge of this Strategy is to increase our skills and capacity within the sector for both water resource management and water services. Institutions must be appropriately staffed and resourced and towards this end we will continue to prioritise skills development, staff motivation and capacity building at all levels. Increasing our regulatory capacity to improve compliance and ensure that standards and license conditions are met is an integral part of strengthening our institutional framework and capacity.

Our sector makes a critical contribution to South Africa's transformation, development and growth objectives. Access to safe water supply and making water available for productive purposes profoundly affects the daily lives of poor people and supports rural livelihoods. Through achieving these objectives we will significantly contribute to equity, redistribution and reducing poverty in South Africa.

South Africa does not face a water crisis at the moment, but is at risk if water is not taken seriously and interventions not applied timeously.

Successful implementation of this Strategy will bring about great benefits: access to water and sanitation for all South Africans, availability of water to support economic growth and job creation, protection of existing assets, stimulation of the construction sector, including small and medium scale enterprises, and protection of our precious water resource for current and future generations. As the Department of Water Affairs, we will provide the necessary leadership to operationalize this Strategy and raise the investment required, however, this requires the collaborative effort of all sectors and stakeholders to make it successful and to ensure that water plays a central role in bringing justice, development and growth for all.

Let's make it happen!

MR T I BALZER
DIRECTOR-GENERAL (ACTING)

EXECUTIVE SUMMARY

The NWRS2 builds on the first NWRS published in 2004. The purpose of the NWRS2 is to ensure that national water resources are protected, used, developed, conserved, managed and controlled in an efficient and sustainable manner towards achieving South Africa's development priorities in an equitable manner over the next five to 10 years.

This Strategy responds to priorities set by Government within the National Development Plan (NDP) and National Water Act imperatives that support sustainable development. The NWRS2 acknowledges that South Africa is a water-stressed country and is facing a number of water challenges and concerns, which include security of supply, environmental degradation and resource pollution, and the inefficient use of water.

In the context of the need for growth, equity and protection of water resources, this Strategy identifies three broad objectives: water supports development and the elimination of poverty and inequality; water contributes to the economy and job creation; and water is protected, used, developed, conserved, managed and controlled in an equitable and sustainable manner. The response to the strategic context and the imperatives set out above is delivered through strategic themes, which discuss in detail the context and challenges, key principles to be sustained, objectives of that particular theme and then proposes strategic actions to achieve the stated objectives.

The most important consideration in all themes discussed is that water is scarce and it requires careful management to enable provision of basic water services and equitable allocation, while meeting the needs of inclusive economic growth without threatening the integrity of aquatic ecosystems. The water resources planning, infrastructure and development theme indicates that surface water sources are limited in many catchments, as indicated by Reconciliation Strategies, and that infrastructure and the costs of construction and maintenance is prohibitive.

South Africa has to prioritise, considering the mix of options available to supply the huge water demands for equitable allocation for development and economic growth. The country will thus consider other potential sources, which include water re-use, desalination, groundwater utilisation, water conservation and water demand management measures, rain water harvesting, recovering water from acid mine drainage, and the import of water intensive goods.

The NWRS2 continues to state that these measures will augment the available water resources in order to support the key developmental objectives of the country. One of the objectives is the equitable allocation of water resources.

The Strategy recognises that the manner in which water was allocated in the past was unequal and favoured only the white section of the population in South Africa. The National Development Plan (NDP) and National Water Act (NWA) collectively inform the intended means to redress past imbalances in the manner in which water was allocated.

The perspective of equity in the Strategy is three dimensional and includes equity in access to water services, equity in access to water resources and equity in access to the benefits from water resource use through economic, social and environmental development and management. The Strategy intends to achieve these objectives through the use of the Water Allocation Reform programme and mechanisms proposed, which include water set aside specifically for redress, compulsory licensing, general authorisations, development support and partnerships to ensure that water is made available to previously disadvantaged groups.

The water resource protection theme emphasises the need to protect our fresh water ecosystems, which are under threat because of pollution from many sources. The need for the determination and preservation of the ecological Reserve and the classification of our river fresh water systems will be a priority. This will assist to determine the nature and the extent of pollution in order to provide appropriate rehabilitation solutions. The Strategy stresses the need for the value of water to be appreciated and for the attitudes and habits of all citizens to change towards water and to work towards its protection. It is reported that climate change will progressively alter the environment in future and present new challenges. The effects of climate change include higher temperatures, altered rainfall patterns and increased occurrence of drought and floods. The Strategy proposes the development of adequate capacity within the sector and the country for monitoring and effective detection and adaptation to protect water and to ensure sustainable water supplies into the future.

Reconciliation Strategies project depletion in the water supplies for some water supply systems in the country. In light of the urgency to protect our water resources and the adverse effects of climate change, the NWRS2 submits that water conservation and water demand management should be one of the top priorities, and measures to reconcile demand and supply in order provide for all our goals of a better life for all through job creation and economic growth.

Research published by the Water Research Commission (WRC) in 2013 indicates that Non-Revenue Water (NRW) for urban supply systems over the past six years was at an average of 36.8%, which is equal to 1 580 million m^3/a from a total urban consumption of approximately 4 300 million m^3/a. This research also indicates that in many municipal water supply schemes, the figures are even worse, with NRW in some cases up to 90%.The irrigation sector, which uses up to 60% of the country's water resources, accounts for losses of between 35% and 45%.

While some municipalities and other institutions have begun to address the challenge of water loss, the NWRS2 emphasises that effort must be intensified with specific targets set to reduce water loss. Water conservation and water demand management measures will have multiple benefits in terms of the postponement of infrastructure augmentation, mitigation against climate change, support to economic growth and ensuring that adequate water is available for equitable allocation. This requires appropriate institutional arrangements and effective governance.

The management and implementation of water strategies requires competent and accountable management. The Strategy outlines the institutional arrangements that will be established or strengthened to co-ordinate activities related to efficient water resource management within a defined geographical area or catchment boundary. The institutions will be required to perform their duties within a developmental management approach that values the involvement of all stakeholders in defining strategies and plans for management within their defined areas. Smart business approaches will be promoted within the total water value chain management and water footprint.

The NWRS2 is developed within a changing environment and acknowledges that monitoring and collecting relevant data will not only affect the accurate assessments of the status of water resources and the magnitude of water problems, but will vastly improve planning and policy formulation processes. National water legislation (Section 68 of Water Services Act) requires the Minister to maintain a national information system to record and provide data on the development, implementation and monitoring of national policy. The monitoring should not be done only for the sake of our national concerns, but also in response to our obligation within international river basins. Approximately 60% of the streamflow in rivers is shared through trans-boundary water systems. South Africa should ensure that Integrated Water Resources Management (IWRM) is implemented in a manner that conforms to international water protocols and treaties, while being compliant with the legislation governing water resource management in South Africa.

A repository of water resource intelligence will facilitate better interpretation and response to the challenges associated with changing hydrological patterns, climate change, groundwater reserves and innovative responses for reference to the country and neighbouring states with whom we share river basins. The NWRS2 also strongly promotes technology and innovation to contribute to effective and efficient water management solutions that respond to the needs for water security and sustainability for individuals, communities, productive and strategic water use as well as ecosystem services.

The research and innovation conducted by the WRC and other research bodies in areas such as wastewater treatment, water quality and water ecosystems, skills and capacity within the sector, climate change and water conservation and water demand management approaches have influenced the themes and interventions contained in this Strategy.

The regulation of the sector to ensure that standards are set and maintained and that there is compliance with the regulatory provisions is a key focus of the Strategy. The achievement of all the country and sector goals must be sustained within an environment that protects the integrity of the National Water Act and all other legislation that has an impact on water resource management.

The Strategy promotes the development of a clear regulatory framework for water resources and coordinating regulatory standards and processes with other government departments and regulatory institutions. Compliance monitoring and enforcement is one of the priorities identified by the Strategy and legal, financial and forensic capacity will be developed to ensure effective prosecution for the ultimate protection of South African water resources against any illegal action by institutions or persons in contravention of the required quality and quantity standards.

The NWRS2 emphasises that the achievement of the vision and objective will require support by strong institutions, competent and capacitated personnel with the requisite financial resources to implement interventions.

A National Water Infrastructure Investment Framework for the Strategy, contained in the financial chapter, outlines the financial capital required to effectively implement all key programmes. This is done within the context that government, development institutions, the private sector and other funders will join hands to provide the necessary funding to support water resource management in the country.

The Strategy also defines the skills required to support effective implementation and outlines the strategy that will be adopted to raise skill levels through collaboration and partnership with various training and skills development institutions, including universities, Further Education & Training (FET) colleges and universities of technology. A collective approach will be sustained within the Water Sector Skills Developments Task Team, which operates under the auspicious of the Water Sector Leadership Group, to identify the skills gap, and to develop relevant educational and training material and competencies at different levels.

The significant challenge that has been identified and is acknowledged within the Strategy is the lack of implementation of clearly defined priorities. The NWRS1 outlined some of the key priorities for the water sector, which include water conservation and water demand management, equitable allocation of water resources, appropriate institutional arrangements and strengthening regulation, but little progress has been made in these areas. There is a need to change the approach to implementation and ensure that priority programmes are given focus and attention. The NWRS2 Implementation Plan thus proposes that key programmes are prioritised, which include water resource protection, infrastructure planning, operation and maintenance, compliance monitoring and enforcement, and institutional arrangements, and that a collective detailed implementation plan is developed in consultation with sector partners to clearly identify roles and set measures to monitor progress.

NWRS2 Vision
Sustainable, equitable and secure water for a better life and environment for all

Goal
Water is efficiently and effectively managed for equitable and sustainable growth and development

Objectives

- Water supports development and elimination of poverty and inequality
- Water contributes to the economy and job creation
- Water is protected, used, developed, conserved, managed and controlled sustainably and equitably

Strategic Themes

- Water Resources planning, development and infrastructure management
- Water Resources protection
- Equitable Water Resource
- Water Conservation and water demand management
- Managing Water Resources for climate change
- Regulation of the Water Sector
- International and trans-boundary water resource management

Execution

- Institutional arrangements
- Financing the water sector
- Monitoring and information management
- Research and innovation
- Water sector skills and capacity

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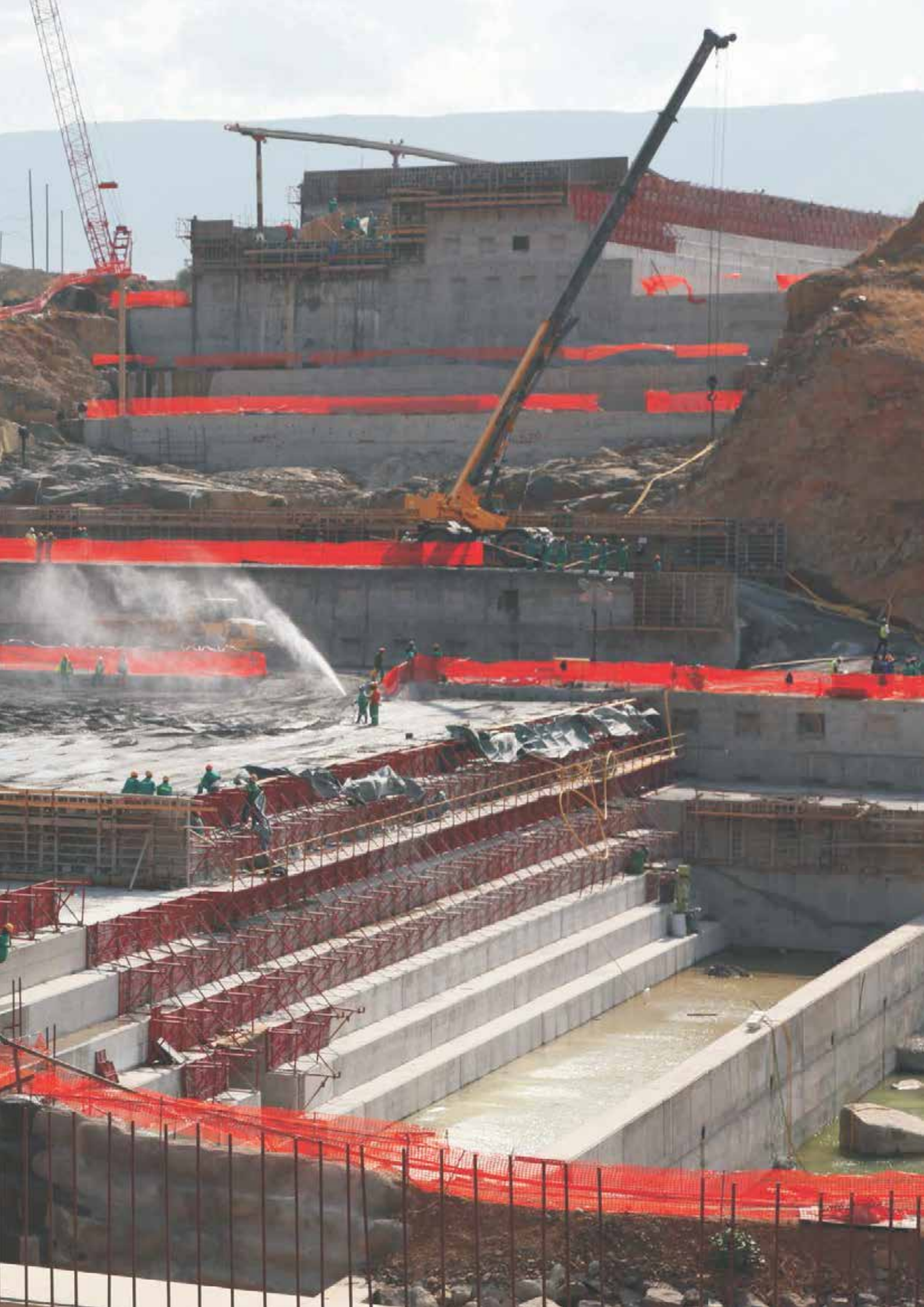
Acronyms and abbreviations

ACIP	Accelerated Community Infrastructure Program
AIP	Alien Invasive Plants
AMCOW	African Ministers' Council on Water
AMD	Acid Mine Drainage
ARC	Agricultural Research Council
b/a	billion per annum
BBBEE	Broad-Based Black Economic Empowerment
bn	billion
BRICS	Brazil, Russia, India, China and South Africa
CARA	Central Adoption Resource Authority
CHE	Council on Higher Education
CMA	Catchment Management Agency
CME	Compliance, Monitoring and Enforcement
CMF	Catchment Management Forum
CMS	Catchment Management Strategy
COP 17	17th Conference of the Parties
CRDP	Comprehensive Rural Development Program
CRU	Central RIA Unit
CSI	Corporate Social Investment
CSIR	Council for Scientific and Industrial Research
CSO	Civil Society Organization
DAFF	Department of Agriculture, Forestry and Fisheries
DBE	Departments of Basic Education
DBSA	Development Bank of Southern Africa
DDT	Dichlorodiphenyltrichloroethane
DEA	Department of Environmental Affairs
DCoG	Department of Cooperative Governance
DHET	Department of Higher Education and Training
DM	District Municipality
DMR	Department of Mineral Resources
DOE	Department of Energy
DHS	Department of Human Settlements
DPE	Department of Public Enterprises
DPSA	Department of Public Service & Administration
DRD&LR	Department of Rural Development & Land Reform
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DWA	Department of Water Affairs
DWAF	Department of Water Affairs & Forestry
DWM	Developmental Water Management
e.g.	for example
EU	European Union
ELU	Existing Lawful Use
etc.	etcetera; and so on
EWSETA	Energy and Water Sector Education and Training Authority
EXCO	Executive Committee
FAO	Food and Agriculture Organisation
FET	Further Education and Training
FET Water	Framework Programme for Research, Education and Training in Water, South Africa (UNESCO initiative)
G8	The Group of Eight (world's eight wealthiest western countries)
GA	General Authorisations
GCM	Global Circulation Models
GCIS	Government Communication Information System
GDP	Gross Domestic Product
GET	General Education and Training

GFETQSF	General and Further Education and Training Qualifications Sub-Framework
GG	Government Gazette
GGP	Gross Geographic Product
GIS	Geographical Information System
GLeWAP	Groot Letaba River Water Development Project
GN	Government Notice
GRIP	Groundwater Resource Information Project
HDI	Historically disadvantaged individuals
ha	hectares
HE	Higher Education
HEI	Higher Education Institutes
HEQSF	Higher Education Qualifications Sub-framework
HRDS	Human Resources Development Strategy
HYDSTRA	Integrated water resources management software
IB	Irrigation board
IDP	Integrated Development Plan
IDZ	Industrial Development Zone
i.e.	that is
IHP	International Hydrological Programme
IPAP3	Industrial Policy Action Plan 3
IPP	Independent Power Producers
IRP	Integrated Resource Plan
IRR	Institutional Reform and Realignment
IT	Information technology
i.t.o.	in terms of
IUA	Integrated Units of Analysis
IWA	International Water Association
IWRM	Integrated Water Resource Management
IWWMP	Integrated Water and Waste Management Plan
IWTTSA	Industry Water Task Team of South Africa
JPTC	Joint Permanent Technical Committee
JSE	Johannesburg Stock Exchange
JWC	Joint Water Commission
KNP	Kruger National Park
KPI	Key performance indicator
LEDP	Local Economic Development Plan
LGSETA	Local Government Sector Education & Training Authority
LHDA	Lesotho Highlands Development Authority
LHWP	Lesotho Highlands Water Project
LRAD	Land Reform for Agricultural Development
LTAS	Long Term Adaptation Scenarios
LWC	Limpopo Watercourse Commission
m3/a	cubic meter per annum
mm/year	millimetres per year
mg/l	miligrams per litre
Ml/day	megalitres per day
MAR	mean annual runoff
MDG	Millennium Development Goals
MFMA	Municipal Finance Management Act
MIG	Municipal Infrastructure Grant
MISA	Municipal Infrastructure Support Agency
MMTS2	Mooi-Mgeni Transfer Scheme Phase 2
MoU	Memorandum of Understanding
MTEF	Medium Term Expenditure Framework
MWIG	Municipal Water Infrastructure Grant
MW	MegaWatts

NATED	National Technical Education
NCBF	National Capacity Building Framework for Local Government
NDP	National Development Plan
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NGA	National Groundwater Archive
NGP	New Growth Path
NGO	Non-government organisation
NGS	National Groundwater Strategy
NMBM	Nelson Mandela Bay Metropolitan
NPC	National Planning Commission
NPS	Non-point source
NPSS	Non-Point Source Strategy
NQF	National Qualifications Framework
NRF	National Research Foundation
NRW	Non-Revenue Water
NSA	National Skills Accord
NSDP	National Spatial Development Perspective
NSDS	National Skills Development Strategy
NSI	National System of Innovation
NT	National Treasury
NWA	National Water Act (Act 36 of 1998)
NWAC	National Water Advisory Council
NWRS	National Water Resource Strategy
NWRS1	National Water Resource Strategy (first edition, 2004)
NWRS2	National Water Resource Strategy (second edition 2013)
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
ORASECOM	Orange-Senqu(River Basin) Commission
ORWRDP	Olifants River Water Resource Development Project
OQSF	Occupational Qualifications Sub-Framework
OSD	Occupation Specific Dispensation
PALAMA	Public Administration Leadership and Management Academy
PES	Present Ecological State
Ph	Phase
PFMA	Public Finance Management Act
PGDP	Provincial Growth and Development Plan
PGDS	Provincial Growth and Development Strategy
PMU	Project Management Unit
PPP	Public Private Partnerships
P/S	pump station
PWC	Permanent Water Commission
QCTO	Quality Council for Trades and Occupations
R&D	Research and Development
R&I	Research and Innovation
RBIG	Regional Bulk Infrastructure Grant
RBO	River Basin Organizations
RDM	Resource Directed Measures
RDP	Reconstruction and Development Programme
REGIS	Software system developed in the Netherlands, currently under investigation for its application in South Africa
RIA	Regulatory Impact Assessment
RIDMP	Regional Infrastructure Development Master Plan
RISDP	Regional Indicative Strategic Development Plan
Rio+20	United Nations Conference on Sustainable Development, 2012
RPL	Recognition of Prior Learning
RQO	Resource Quality Objectives

RSA	Republic of South Africa
RSAPIII	Regional Strategic Action Plan III
RWH	Rainwater harvesting
RWU	Regional Water Utility
RWQO	Receiving Water Quality Objective
SA	South Africa
SAAWU	South African Association of Water Utilities
SADC	Southern African Development Community
SAICE	South African Institution of Civil Engineering
SALGA	South African Local Government Association
SAWS	South African Weather Service
SDC	Source Directed Controls
SETA	Sector Education & Training Authority
SIP	Strategic Integrated Project
SIWI	Stockholm International Water Institute
SULP	Sustainable Utilization Plans
SWPN	Strategic Water Partnership Network
TAC	Technical Advisory Committee
TCTA	Trans Caledon Tunnel Authority
UDF	Urban Development Framework
UN	United Nations
UNCSD	United Nations Conference on Sustainable Development
UNEP	United Nations Environment Programme
GEMS	Global Environment Monitoring System
UNFCCC	United Nations Framework Convention on Climate Change
UNESCO	United Nations Educational, Scientific and Cultural Organization
VGG	Vaal Gamagara
WAR	Water Allocation Reform
WAS	Water Accounting System
WARMS	Water Registration Management System
WARS	Water Allocation Reform Strategy
WCWSS	Western Cape Water Supply System
WCWDM	Water Conservation and Water Demand Management
WDCS	Waste Discharge Charge System
WISA	Water Institute of Southern Africa
WMA	Water Management Area
WMP	Water Management Plan
WMS	Water Management System
WRA	Water Research Act
WRC	Water Research Commission
WRM	Water Resource Management
WRTC	Water Resources Technical Committee
WS	Water Services
WSA	Water Services Authority
WSAct	Water Services Act (Act 108 of 1997)
WSDP	Water Services Development Plans
WSLG	Water Sector Leadership Group
WSP	Water Services Provider
WMA	Water Management Area
WTW	water treatment works
WWC	World Water Council
WWTW	waste water treatment works
WUL	Water Use License



CHAPTER 1
INTRODUCTION

1.1 Purpose and scope

The purpose of this second edition of the National Water Resource Strategy (NWRS) is to ensure that national water resources are managed towards achieving South Africa's growth, development and socio-economic priorities in an equitable and sustainable manner over the next five to 10 years.

In terms of the National Water Act (Act 36 of 1998), the purpose of the National Water Resource Strategy is to:

- facilitate the proper management of the nation's water resources
- provide a framework for the protection, use, development, conservation, management and control of water resources for the country as a whole
- provide a framework within which water will be managed at regional or catchment level, in defined water management areas
- provide information about all aspects of water resource management
- identify water-related development opportunities and constraints

The NWRS is the legal instrument for implementing or operation alising the National Water Act (Act 36 of 1998) and it is thus binding on all authorities and institutions implementing the Act. It is the primary mechanism to manage water across all sectors towards achieving national government's development objectives. This is the second edition of the NWRS, as required under the National Water Act (Act 36 of 1998) (NWA). The first edition (NWRS1) was published in 2004, and was the blueprint for water resources management in the country. The NWA requires that the Strategy is reviewed every five years.

While there is a legislative requirement under the NWA to develop a national water resource strategy, there is also a need to respond to new strategic drivers, challenges and priorities. The second edition of the Strategy (NWRS2) outlines the key challenges, constraints and opportunities in water resource management and proposes new approaches to be adopted in ensuring effective responses these to challenges, constraints and opportunities.

To achieve an inclusive, sustainable and equitable economy, this NWRS2 sets out the vision, principles, goals and strategic actions for achieving effective developmental water management, with a particular, but not exclusive, focus on the role of the State, specifically the Department of Water Affairs (as water sector leader), associated sector departments (impacting water resources and its management), catchment management agencies, water services authorities, water board, and other organs of state with a responsibility for water management. It also focuses on the importance of water use sectors, communities, civil society, and the private sector becoming involved in and committing to developmental water resource management.

1.2 Reasons for a revised National Water Resource Strategy

Since the promulgation of the NWA in 1998 and since the development of the NWRS1 in 2004, South Africa has evolved into a very different country. The National Development Plan (NDP) of November 2011 outlines a new path for South Africa, which seeks to eliminate poverty and reduce inequality by 2030. It seeks to:

- Create jobs and livelihoods
- Expand infrastructure
- Transition to a low-carbon economy
- Transform urban and rural spaces
- Improve education and training
- Provide quality health care
- Build a capable state
- Fight corruption and enhance accountability
- Transform and unite society

The NDP cannot be effectively implemented unless all sectors contribute to the vision and objectives of the plan.

This NWRS2 responds to the NDP and outlines the strategy for protecting, using, developing, conserving, managing and controlling South Africa's scarce water resources towards achieving the 2030 Vision. It is a strategy for all sectors and stakeholders who use and impact upon our water resources.

1.3 Process to develop the NWRS2 (2013)

This NWRS2 builds on the NWRS1 that was published in 2004.

A broad range of stakeholders was consulted through a highly inclusive process towards identifying the strategic direction for water resource management. Therefore, the NWRS2 represents the aspirations of many South African individuals and institutions, building upon existing policy, legislative mandates and the strategic vision of our government, including development and economic growth ambitions.

1.4 Reflecting on the NWRS1 (2004)

The NWRS1 is a comprehensive strategy that defined the fundamentals of integrated water resource management and presented a clear perspective of the water situation in South Africa with associated critical actions required. The NWRS2 builds on the progress that was made with the implementation of the NWRS1.

Table 1 highlights successes and weaknesses in the implementation of the NWRS1. The summaries of the Reconciliation Strategies present additional information on the progress made in the implementation of the NWRS1 since 2004.

Achievements	Outstanding Challenges
• Development of new water resources and water supply infrastructure and an investment in improved dam safety for state dams • Water Reconciliation Strategies in major urban areas and improved insights into reliable future water demands and supplies • A significant proportion of reserve determinations have been done with different level of confidence. • Incentive-based regulation through Blue and Green Drop assessments • Improved sector collaboration and participation • A Learning Academy to improve skills and capacity within the sector • Two Catchment Management Agencies established • Support givento numerous resource-poor farmers • Water sharing agreements and Institutional arrangements in place in all trans-boundary basins	• Achievement of water conservation and demand management targets • Streamlined water allocation reform to redress past racial and gender imbalances in access to water for productive uses and to address poverty and inequality • Implementation of environmental flow monitoring • Establishment of water management institutions and the decentralisation of water resources management • Strengthening of regulation of water resources and water quality • Improvement of technical and management skills to implement developmental water management. • Improvement in the integration of monitoring and information management • Reduction in the backlog of infrastructure maintenance

Table 1: Implementation Analysis of the NWRS1

CHAPTER 2
NATIONAL STRATEGIC IMPERATIVES

The NWRS2 responds to South Africa's vision for 2030, as articulated in the National Development Plan (NDP) and to the national government outcomes outlined in National Government's Programme of Action for 2010-2014. These priorities are key drivers for change and, as such, are the national strategic imperatives that shape this Strategy.

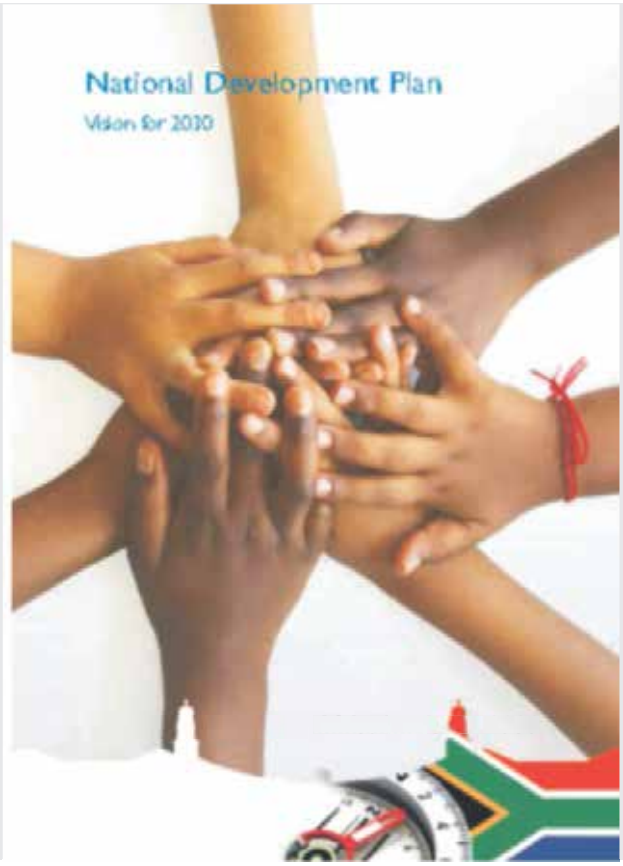
2.1 South Africa's Vision 2030

In its Vision 2030, the NDP articulates the national development goal of eradicating poverty and sharply reducing inequality by 2030.

To achieve this, Government has defined a New Growth Path (NGP), one of inclusive growth and development, with a focus on diversification and wide participation by South African citizens within a vibrant and growing economy.

As water plays a central role in all sectors, including agriculture, energy, mining, industry, tourism, urban growth and rural development, the allocation, development and protection of water is an essential prerequisite for inclusive economic growth, poverty reduction and the significant reduction of inequality in South Africa.

The NWRS2 analyses the role of water in the economy and identifies the specific challenges, development opportunities and actions that inform an agreed framework for priority areas of focus for the country. It thus seeks to address concerns about socio-economic growth and South Africa's potential, which may be restricted if water security, resource quality and associated water management issues are not resolved in time. The NWRS2 aims to ensure that water serves as an enabler for inclusive economic and social development and not a hindrance.



- Create jobs and livelihoods
- Expand infrastructure
- Transition to a low carbon economy
- Transform urban and rural spaces
- Improve education and training
- Provide quality health care
- Build a capable state
- Fight corruption and enhance accountability
- Transform and unite society

The National Water Resource Strategy is developed within a national context that promotes equity, job creation, growth, development and other important objectives. It is critical that the NWRS2 addresses these national strategic goals to remain relevant to the development aspirations of the country. The development objectives are clearly outlined in the NDP.

The NWRS2 provides a framework that ensures that water resources are protected and conserved for the long term, but also contribute to the attainment of the social and economic goals of the country.

2.1.1 National Planning Commission's Vision 2030 and alignment with NWRS2

The National Planning Commission has paid particular attention to water issues and how they impact on and influence our development pathways and opportunities. **Table 2** illustrates some areas where strong alignment with the Vision 2030 targets and actions need to be made. Detailed plans and actions will be explored in the relevant sections of this document.

Vision 2030 theme	Targets and actions for Vision 2030	Water sector programme and alignment
Economy and employment	11 million jobs created by 2030	• Infrastructure development programmes • Water conservation and water demand management - fixing leaks, retrofitting, plumbing • Wastewater treatment turn-around programmes • Infrastructure asset management • Integrated catchment management and resource protection • Ensure water availability to economic sectors to create jobs • Recruitment programmes for scientists, technicians, engineers, managers and development practitioners
Economic Infrastructure	Ensure people have access to clean, potable water and there is enough for agriculture and industry recognising trade-offs in the use of water	• Development, operation, maintenance and refurbishment of water resources infrastructure • Accelerated community infrastructure programme (ACIP) • Regional bulk infrastructure grant (RBIG) programme • Supportto historically disadvantaged individuals (HDI) farmers

Table 2: National Planning Commission's Vision 2030 and alignment with the NWRS2

Vision 2030 theme	Targets and actions for Vision 2030	Water Sector programme and alignment
Economic Infrastructure	Reduce water demand in urban areas to 15% below business as usual scenario by 2030	• Promotion of ater conservation and water demand management (WCWDM) programme in all sectors and putting in place measures for water loss reduction in urban areas. WCWDM is a priority programme and actions have been developed to address targets set
	Complete Lesotho Highlands Water Project Phase 2 by 2020	• Project prioritised by DWA and the Trans Caledon Tunnel Authority (TCTA)
	Comprehensive management strategy including an investment programme for water resource development, bulk supply, and waste water management for major centres by 2012 with review every five years	• Water infrastructure investment framework • Regional Bulk Infrastructure Programme • Green Drop assessment
	Create regional water and waste water utilities and expand mandates of existing water boards (between 2012 and 2017)	• Institutional establishment process already considering options for configuration of Regional Water Utilities
Transition to a low carbon economy	Stimulate renewable energy and retrofit buildings	• Department of Mineral Resources (DMR), DWA and Eskom partnership established and task team already considering sites for hydro-power stations
Inclusive rural economy	Substantial increase investment in irrigation infrastructure in Makatini Flats and Mzimvubu River Basin	• Planning and assessment of Mzimvubu Dam options well advanced
	Active rural economies through improved infrastructure and service delivery	• Water supply programme • Accelerated Community Infrastructure Programme • Water Allocation Reform • Regional Bulk Infrastructure Grant

Vision 2030 theme	Targets and actions for Vision 2030	Water Sector programme and alignment
SA in the region and the world	Develop regional market for food, energy and water and putting in place water management agreement with neighbouring countries	• International relations and co-operation • Trans-boundary treaties, agreements and institutional arrangements
Education and innovation	Improve the system of skills planning and shaping production of skills Develop a set of strong qualifications and support for non-formal programmes	• DWA Learning Academy • Water Sector Skills Development Strategy developed to improve skills planning and production of relevant skills for the sector
Social protection	Number of public works jobs should rise from the present level to about 1 million in 2015 and 2 million by 2030	• Align all infrastructure development programmes with public works jobs and labour intensive methods • Water conservation and water demand management fixing of leaks programme • Operation and maintenance and waste water treatment rehabilitation programmes • Water supply projects
Building a capable state	A formalised graduate recruiting scheme for the public service, skills strategies for managers, technical, professional and local government staff	• DWA Learning Academy • Mentorship programmes • Occupational specific dispensation (OSD) posts
	Develop regional water utilities to deliver some local government services on an agency basis where local or district municipalities lack capacity	• Establishment of Regional Water Utilities

2.1.2 Alignment with National Government Outcomes

The NWRS2 seeks to develop an appropriate balance between supply and demand-driven approaches, considering the specific constraints pertaining to the resource. The express intention of the NWRS2 is to place water at the heart of all planning in the country so that any decisions that rely on the steady supply of water, factor in water availability adequately.

Most sectors and national and sector strategies now acknowledge the importance of water and that development cannot happen without water planning and development or corresponding budget allocations. However, for water to play an optimal role in poverty eradication, the reduction of inequality, inclusive growth and development, and building a just and equitable society, water resources planning must be integrated into national, provincial and local planning, and must be addressed in all growth and development strategies.

2.1.3 National Government Outcomes

The Cabinet Lekgotla in January 2010 adopted 12 Government Outcomes, which are the key indicators for the National Government's Programme of Action for 2010 - 2014. **Table 3** highlights some high level strategies and plans that must be integrated with water planning to achieve national development objectives and outcomes.

2.2 Water sector challenges

Outcome 2: A long and healthy life for all South Africans
Water is fundamental requirement for human health and well-being.The NWRS2 makes provision for the allocation of water to meet basic human needs and includes a sub-strategy for the protection of water resources.

Outcome 5: A skilled and capable workforce to support an inclusive growth path
TheNWRS2 recognises the importance of a technically competent workforce in the sustainable management of water resources and includes a sub-strategy for water sector capacity building.

Outcome 6: Provision for investment in water infrastructure to support economic development
The NWRS2 makes provision for investment in water infrastructure to support economic development through a strategy for infrastructure development and management and the National Water Sector Investment Framework.

Outcome 7: Vibrant, equitable and sustainable rural communities with food security for all
The NWRS2 adopts the principle of 'source to tap and back to source' and the maximisation of local water resources to improve access to adequate water for domestic and productive use, particularly in rural communities. The equity and redress focus of the NWRS2 is inline with supporting Outcome 7.

Outcome 8: Sustainable human settlements and improved quality of household life
TheNWRS2 makes provision for the allocation of water to meet basic human needs and water planning that supports local economic growth and job creation.

Outcome 9: A responsive, accountable, effective and efficient local government system
The NWRS2 provides options for water resource development to meet water supply and sanitation services for a growing population and for the provision of higher levels of service.

Outcome 10: Environmental assets and natural resources that are well protected and continually enhanced
A strategic goal of the NWRS2 is the protection of water resources and associated aquatic ecosystems, and a sub-strategy for the protection of water resources and a regulatory framework for water resources are included.

South Africa is a water-stressed country and is facing a number of water challenges and concerns, including security of supply, environmental degradation and resource pollution. The limited water resources require careful management to enable the provision of basic water services to every citizen, while meeting the needs of economic growth without threatening the environmental integrity of water resources.

The sustainability of the country's fresh water resources has reached a critical point and its associated management is now at a crossroads. The NWRS2 sets the strategic direction for water resource management in the country over the next five years, subject to continuous review, as required, with a focus on priorities and objectives for 2013 - 2017. It provides a developmental and transformational framework for the protection, use, development, conservation, management and control of water resources for South Africa, as well as the framework, within which water must be managed at catchment level, in defined water management areas.

The National Water Policy pronounces that

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

Table 3 provides the water context as a back ground to the strategic goals of the NWRS2.

Issue	Status quo
Water scarcity	South Africa has low levels of rainfall relative to the world average, with high variability and high levels of evaporation due to the hot climate, and increasing challenges from water pollution. South Africa is the 30th driest country in the world and has less water per person than countries widely considered to be much drier, such as Namibia and Botswana.
Water runoff	The variable rainfall distribution and characteristics give rise to the uneven run-off and distribution of water resources across the country, with more than 60% of the river flow arising from only 20% of the land area. Water runoff is thus highly variable and unevenly spread in space and time.
Water resource infrastructure	There is well-developed infrastructure, with more than 4 395 registered dams in South Africa, including 350 dams that belong to the DWA and a number of large-scale inter-basin water transfer schemes. However, many parts of the country have either reached or are fast approaching the point at which all of the financially viable freshwater resources are fully utilised and where building new dams will not address the challenges. There are also backlogs in the maintenance and rehabilitation of water infrastructure.
Floods and droughts	Despite good infrastructure, floods and droughts are part of the normal water cycle and water restrictions and flood management are a critical part of the water business.
Water demand	Many parts of the country are fast approaching the point at which all of the easily accessible freshwater resources are fully utilised. It is imperative that all South Africans recognise this situation so that the necessary steps are taken to assess current and future demands for water.
Water planning and shortages	For the purpose of water planning, the DWA plans with available water and uses a 98% assurance of supply (DWAF, 2004), which means that water can be abstracted at the determined yield, 98 out of 100 years, on average. There is about 10 000 million m3 per year available with this level of assurance from a total mean annual runoff of 49 000 million m3 (thus, only approximately 20% of run-off is available as assured yield). In most areas where there are water deficits or where the system is considered to be 'in balance', the probability is that water shortages are experienced more than 2 out of 100 years. Water shortages have become part of life in South Africa and will be more frequent unless the strategies put forward in this NWRS2 are timeously implemented.
Mean annual runoff (MAR) and ecological Reserve	Approximately 25% of the MAR of 49 000 million m3/a needs to remain in the rivers and estuaries to support ecological functioning of the catchments, depending on the specific river systems. In many water management areas the ecological portion of the Reserve is not yet fully implemented.
Economically available yield	Most of the economically available yield from surface water resources over large parts of the country has been fully developed and utilised. More than two thirds of the country's MAR is already stored in dams. Where additional water is still available, such as in the uThukela, Mzimvubu and Phongolo basins, it is located in relatively remote areas far from existing centres of demand.
Volume of surface water yield	Surface water from dams and direct abstraction from rivers accounted for 9 500 million m3/a, with a significant volume of the surface water yield (3 000 million m3/a) moved via inter-basin transfers to areas in the country where requirements exceed supply. An example is the Lesotho Highlands Water Scheme, which supplies water to Gauteng through transfer from the Katse and Mohale Dams in Lesotho to the Upper Vaal Water Management Area (WMA). The Mzimvubu to Keiskamma WMA is currently the only WMA that is not subject to inter-basin transfers.
Ground water potential	Groundwater is a significant source and is often the only water resource in many parts of the country, although local yields are usually quite low. The most recent estimate of sustainable potential yield of groundwater resources at high assurance is 7 500 million m3/a, while current groundwater use is estimated at around 2 000 million m3/a. Allowing for an underestimation on groundwater use, about 3 500 million m3/a could be available for further development.

Issue	Status quo
Water quality challenges	The main contributors to water quality problems are mining (acidity and increased metals content), urban development (salinity, nutrients and microbiological), industries (chemicals and toxins) and agriculture (sediment, nutrients, agro-chemicals and salinity through irrigation return flows). Untreated or poorly treated wastewater is severely affecting the quality of water in many areas.
Water resources quality	South Africa's water ecosystems are not in a healthy state. Of the 223 river ecosystem types, 60% are threatened, with 25% of these critically endangered. Less than 15% of river ecosystems are located within protected areas, many of which are threatened and degraded by upstream human activities. Of 792 wetland ecosystems, 65% have been identified as threatened and 48% as critically endangered. Acid mine drainage (AMD) has also been reported from a number of areas in South Africa, including the Witwatersrand Gold Fields, the Mpumalanga and KwaZulu-Natal Coal Fields and the O'Kiep Copper District.
Inefficient use of water resources	Despite being a water-scarce country, South Africa faces high levels of water wastage and inefficient use. In municipalities, non-revenue water sits at more than 37% on average, and in many irrigation and municipal supply schemes it is worse, with estimated losses of up to 60%. As such, schemes often have no formal record or measurement of actual losses.
Shared water basins	South Africa shares four major river systems with six neighbouring states (Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe). International agreements on water sharing are in place in all of these river basins, in line with the Revised SADC Protocol on Shared Watercourses.

Table 3: The water context as a background to the strategic goals of the NWRS2

2.3 Water for sustainable growth and development

South Africa's growing economy and social development is giving rise to growing demands for water. Water plays a central role in most of these national planning initiatives, such as agricultural development, energy security, tourism and recreation, mining, industry and municipal water supply. The reliable supply of water in sufficient quantities and at the required quality is a crucial input to economic growth and job creation.

2.3.1 Current needs

The contribution and current water needs to the major economic sectors is highlighted in **Figure2.**

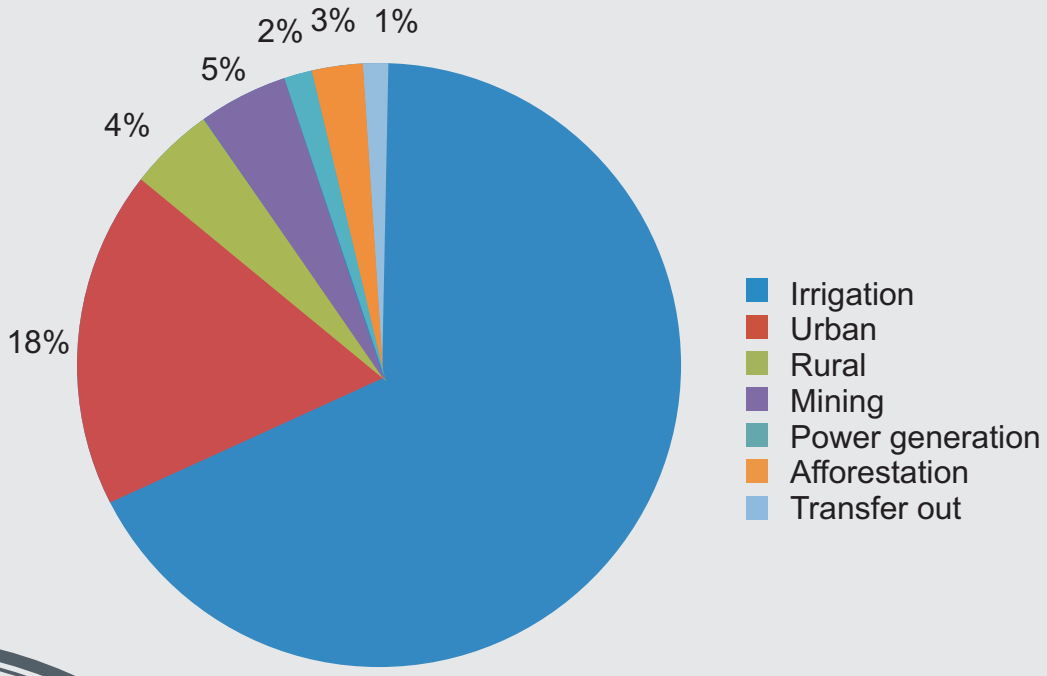


Figure 2: Contribution and current water needs to the major economic sectors

Agriculture sector: About 8.5 million people are directly or indirectly dependent on agriculture for employment and income (GCIS, 2011). The sector contributes about 3% to the GDP and 7% to formal employment. The agricultural sector is made up of commercial farmers and subsistence farmers and about 1.3million ha are irrigated. The New Growth Path (NGP) has set a target of 300 000 households in small holder schemes by 2020 and 145 000 jobs to be created in agro-processing by 2020 (DED, 2010). Irrigated agriculture is the largest single user of water in South Africa (60%) and it has a huge potential socio-economic impact in rural communities. Water is the major limiting factor in the growth of this sector and poor water quality has a negative impact on agricultural exports and associated foreign income.

Energy sector: Although only using 2% of water, this sector contributes about 15% to the GDP of South Africa and creates jobs for 250 000 people (GCIS, 2011). The sector generates about 95% of South Africa's electricity and exports it to countries in Africa. Power generation remains a water use of strategic importance (See section 2.3.2).

Mining sector: According to the Chamber of Mines of SA, the mining sector contributed 8.8% directly and 10% indirectly to South Africa's GDP in 2009 (GCIS, 2011). It creates about one million direct and indirect jobs. The sector accounts for approximately one third of the market capitalisation of the JSE and it is the major attractor for foreign investments. The NGP has set a potential employment target of 140 000 new jobs by 2020 for the mining sector (DED, 2010). Mining and related activities require significant quantities of water and impact on the environment through associated potential pollution. The mining sector is also faced with legacy issues of past pollution, for example, acid mine drainage. The development of new mines in water-scarce areas requires planning to make arrangements for the transfer of water and development of new sources, and appropriate attention to waste processing and remediation.

Manufacturing sector: The manufacturing sector contributed15.5% to the GDP and13.3% to jobs in 2009 (GCIS, 2011).The NGP has set a target of 350 000 new jobs for this sector by 2020. Water is required in the manufacturing processes and it used for cooling.

Tourism sector: In 2009, the tourism sector directly and indirectly contributed 7% to the GDP and it created 575 000 jobs (GCIS, 2011). This sector is earmarked for high economic growth, which is expected to generate a significant number of new jobs. The NGP has set a target of 225 000 new jobs by 2015 (DED, 2010). Drinking water quality that matches international standards and reliable water supply and sanitation services are critical to the success of this sector. Many tourism sites require on-going attention to aquatic ecosystems.

2.3.2 Strategic water use

In terms of section 6(1)(b)(iv) of the NWA, the NWRS2 makes provision for the allocation of water for strategic use and lists two key areas that will be targeted for this purpose in terms of the allocation priority as outlined in **Chapter 6** on Equitable water allocation. Strategic water use is particularly important to the National Development Outcomes and the economy as a whole and includes:

- The transfer of water from one water management area to another
- The continued availability of water to be used for electricity generation throughout the country.

The energy sector, including Eskom, the national power generator, is highly dependent on reliable supplies of water for the generation of electricity (steam generation and cooling processes). An elaborate and sophisticated network of water transfer and storage schemes has been developed specifically to support this sector and ensure high levels of reliability. Conversely, the water sector is highly dependent on a constant and reliable supply of electricity to move or transfer water. This priority will be supported in the manner that responds to imperatives of development, within appropriate regulatory provisions and resources. Stakeholders will be mobilised and engaged to secure the future of the economy in terms of all strategic water use elements.

2.3.3 Future water needs and associated impacts

South Africa's growing economy and social development is giving rise to increasing demands for water. Given the limited water resources available, it is not likely to be easy or economically feasible to meet all the demands that may arise. Many parts of the country are fast approaching the point at which all economically exploitable freshwater resources are utilised. New approaches will have to be adopted to balance demand and supply, particularly in the most stressed inland catchments where much of South Africa's economic growth and social development are occurring. Meeting water demands is also important in rural areas to stimulate economic growth.

Agriculture: The Irrigation Strategy for South Africa has set a target of an increase of more than 50% of irrigated land in South Africa. For future scenarios, the DWA assumes that the amount of water allocated for agriculture remain the same; all land reform projects and revitalisation of smallholder irrigation schemes will use the same amount of water as before. An increase in irrigation will be effected through water-use efficiency, and selected new development, such as in the Mzimvubu.

Mining: There are thousands of mine workings that are abandoned or derelict in South Africa. At the same time, new mining operations are underway, particularly for coal and platinum. Some of these new mines are in water-scarce areas (for example, in the Lephalale and Steelpoort Valley areas) and these activities will put more pressure on the water resource. Both abandoned and new mines also pose a water pollution threat.

Forestry: Development opportunities for forestry are confined to high rainfall zones, such as in the Eastern Cape. For the sector to grow, more forestry areas are needed, but growth can also be enhanced by downstream processing activities, such as sawmills, pulping and paper production. Downstream activities, however, may use considerable amounts of water and pollute water resources. Forestation will reduce stream flow and protect bio diversity, especially in KwaZulu-Natal, the Eastern Cape and, to a lesser extent, in Mpumalanga and Limpopo Provinces.

Energy sector: Energy production capacity is expected to increase as the Department of Energy is planning significant investment in new power generation capacity. Current plans include building dry-cooled coal-fired power stations that will be more water efficient. However, these power stations are located in water-scarce areas, and would strain available water resources. The return to service of older power stations, which are wet-cooled, has further burdened available water resources. The NDP proposes the use of renewable energy sources to mitigate carbon emissions. Renewable energy, such as solar energy, may also need cooling water.

Sasol: Sasol 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 options are currently under consideration.

Climate change: Scenarios currently indicate that the net effect of climate change for South Africa will be a reduction of water availability, although impacts will be unevenly distributed, with the eastern coastal areas of the country 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 will probably lead to weather events that are more intense and variable, such as sudden high volumes of rainfall, leading to flooding.

Economic growth: The NWRS1 estimated a high scenario economic growth rate of over 4% up to 2025 and a low scenario growth rate of 1.5% per year up to 2025. Growth up to 2009 was, on average, 3.7%. Targets are high for the coming years, as Government's NGP aims to create five million new jobs by 2020. However, these plans may be influenced by changes in global growth.

NSDP: The National Spatial Development Perspective (NSDP) of 2006 identified 26 priority growth areas in South Africa and water scarcity was identified as a constraint in the major urban centres, which are experiencing rapid population growth due to the migration of people from rural areas to urban centres. Therefore, the DWA has focused its planning efforts on the metropolitan areas where the needs are most urgent.

2.3.4 Sustainable growth and water security

To date, South Africa's water security has mainly relied on surface (fresh) water and its development. Extensive work has been done in terms of specific growth and development areas, which provides sufficient information to plan specific development and to present strategic perspectives on development requirements. Based on water Reconciliation Strategies, surface water availability and its remaining development potential will not be sufficientt o support the growing economy and associated needs in full.

- Surface water development potential only exists in a limited number of water management areas, while serious challenges remain in the majority of water management areas. Where additional water is still available, such as in the uThukela, Mzimvubu and Pongola basins, it is located in relatively remote areas, far from existing centres of demand. The limits to the development of surface water sources have almost been reached and the opportunities for economic siting of new dams are few (DWA, 2010).
- The costs of transfers per cubic metre to locations where water is needed are also rising, with longer distances and escalating energy costs. In addition, the development of new water resources infrastructure is a complex and time-consuming process that typically takes more than a decade from inception to commissioning (DWA,2010). For larger and more complex projects with environmental and political sensitivities, the lead times may be more than two decades. This highlights the need for careful planning with long time horizons. Therefore, to meet growing demand, South Africa will need to exploit alternative resources.
- The water balance developed in the NWRS1 showed that South Africa's surface water resources would be depleted over the medium term and that a mix of water resources would be required to reconcile supply and demand. The options to address the detailed planning needs have been proposed and explored in Reconciliation Strategies that have been developed to inform water resource investment and management decisions for large systems supplying areas of major economic importance and specific cities and towns. The Reconciliation Strategies and All Town Studies developed by the DWA are discussed in more detail in **Chapter 4.**

Summary of key strategic messages from detailed Reconciliation Strategies:

- WCWDM is extremely important in all areas – South Africa cannot afford to waste any water, anywhere, anymore
- Groundwater is important, currently under-valued and under-used
- There is a huge potential for increase in re-use at the coast and in inland systems
- There is a limited opportunity for more dams and transfer schemes, but they are inevitable in certain areas; however, this option is very expensive
- Desalination should be considered as an option to increase supply of water, especially in coastal areas with limited sources of supply
- Additional water for increase in irrigation in South Africa is very limited and moving some water from irrigation to other use must already be considered in certain areas. Irrigation development has been very slow since the NWRS1, due to the unavailability of cheap water

To ensure sufficient water of an appropriate quality is provided for the socio-economic needs of the country, while still ensuring sufficient water for protecting aquatic ecosystems, all of the water resources sources in the water mix should be explored and developed. Based on water Reconciliation Strategy studies, surface water availability and its remaining development potential will not be sufficient to support the growing economy and associated needs in full. To meet growing demands, South Africa will need to exploit alternative resources.

CHAPTER 3 VISION, GOAL, PRINCIPLES AND OBJECTIVES

3.1 Vision

The water sector vision for the National Water Resources Strategy 2, as aligned with the vision of South Africa 2030, is:

Sustainable, equitable and secure water for a better life and environment for all

3.2 Goal

Towards achieving this vision, the overall goal is:

Water is efficiently and effectively managed for equitable and sustainable growth and development

3.3 Objectives

This strategy strives to achieve three main objectives, as outlined in **Figure 3.**

Figure 3: Objectives of the NWRS2

The objectives in the figure above address South Africa's major social and economic objectives as well as the need to ensure a sustainable water resource. Each objective is described in the following three sections.

3.3.1 Objective 1: Water supports development and the elimination of poverty and inequality

This objective is primarily about equity. The NWRS2 is centred on the recognition of water as a basic human need and the recognition of its critical role in ensuring equitable socio-economic development.

The principle of equity means that special attention must be given to the needs of those that were historically denied access to water or to the economic benefits of water. Equity implies a concept of fairness, which allows for different practices in the management of water in response to different social, economic and environmental needs. Equity encompasses fair attention to the needs of future generations.

To bring equity to a practical level, it is important to address equity at all levels, including:

- equity in access to water services
- equity in access to water resources
- equity in access to benefits from water resource use through economic, social and environmental development and management

Equitable access to water or to the benefits derived from using water is critical to eradicating poverty and promoting equitable economic growth. Little substantive progress on the National Water Act pillar of equity (redress of race and gender water allocations for productive economic use) has been achieved since its promulgation. Proactive steps are required to meet the water needs of historically disadvantaged individuals (HDIs) and the poor and ensure their participation in productive use of water.

Priorities to ensure equity in water allocation:

- Elevate the public and political profile of the Water Allocation Reform (WAR) programme and strengthen linkages to broader government and private sector programmes of redress in land, agriculture and business.
- Implementation of compulsory licensing in stressed catchments to ensure that water is made available for historically disadvantaged individuals (HDI).
- Utilise General Authorisations to form an important tool in achieving redress and making water available to small water users.

While all the chapters address equity, **Chapter 6** (Equitable Use and Allocation) addresses this objective in detail from a water resource perspective.

3.3.2 Objective 2: Water contributes to the economy and job creation

South Africa as a democratic developmental state has a responsibility to grow the economy and support job creation towards reducing inequality and defeating poverty. The New Growth Path (NGP) has identified economic sectors that have a potential for creating employment on a large scale, and water is critical for meeting economic growth and job creation targets. The NGP looks to the green economy, agriculture, mining, manufacturing and tourism industries for most of the employment opportunities.

Economic growth and development have major implications for the water sector, which need to be addressed.

- Economic growth implies that more water will be required. However, water is not always in surplus and growth will only be possible through the optimised use of existing water resources, expensive imports and/or re-allocation.

- Economic growth has to be planned in the context of sector-specific water footprints, which include the water use footprints, the various water and environmental impact footprints, as well as the relevant socio-economic impacts and contributions.

- All sectors of the economy will be expected to consider water resource requirements and their availability in attaining a balanced and a sustainable use of water resources.
  The NWRS2 reaffirms the role and purpose of water, which, according to the National Water Act, is to enable and facilitate prosperity through providing water to the various social and economic sectors for growth and development.

Job creation

The NDP has targeted that 11 million jobs should be created by 2030. This requires each sector to develop plans and ensure that their programmes have a bias for labour intensive approaches in order to contribute to job creation. Job creation should be prioritised and remains a key intervention on poverty alleviation, eradication of inequality, women and youth empowerment and the water sector has a key role to play in this regard.

Potential for job creation grouped as follows

- **Job creation through water infrastructure development:** This includes major water infrastructure, regional bulk infrastructure and municipal infrastructure. Water infrastructure jobs, however, could employ local workers, and provide skills, development and work experience at a number of levels, from highly technical jobs to manual labour.

- **Job creation through water functional management:** This involves more sustained job opportunities created in functional in areas of water management,meaning that, wherever possible, water mangement will promote job creation in areas such as operations and maintenance, water conservation and water demand management, wastewater turn-around programmes, infrastructure asset management, and integrated catchment management and resource protection.

- **Job creation through water provisioning to economic sectors:** The greatest job creation opportunities lie within economic sectors such as agriculture, mining, industry and tourism. Water is a key enabler in the expansion of these sectors, whether it is in relation to large enterprises, small-scale or even micro-enterprises. Water is the critical resource that is required for improved the viability of these important high-water-use sectors, including the energy and manufacturing sectors.

3.3.3 Objective 3:
Water is protected, used, developed, conserved, managed and controlled sustainably and equitably

Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. Since the majority of the macro goals are water-resource related (from a supply and impact perspective), water and its management must form an integral part of the development planning framework. The NDP asserts that South Africa needs to move away from the unsustainable use of natural resources. The NWA emphasises the protection of the quality of water resources to ensure sustainability of the nation's water resources in the interests of all water users.

Protection of water resources is necessary for securing ecosystem services for economic development and growth and protection of human and animal health. Protection of water resources encompasses management of quality and quantity of both surface water and groundwater and protection of the habitats.

Threat to water resources

- A significant proportion of South Africa's usable water resources, including aquatic ecosystems, have been degraded and most exploitable water resources are utilized.
- The already substantial pressures on fresh water and estuarine ecosystems are expected to be worsened by climate change.
- The protection of our water resources remains a key focus of the NWRS2 and **Chapter 5** on Water resource protection will outline measures that will be taken to ensure long term sustainability of our resources.

The efficient use of water is also an important factor in preserving water resources and ensuring availability to achieve the South African Vision 2030. This had already been identified as a priority strategy in the NWRS1, and is critical in ensuring sufficient water for South Africa's needs is available. Although efforts are being made to implement water conservation and water demand management, they must be improved to ensure that all sectors develop measures and plans to save water. Improved water-use efficiency will require changes in the approach of all water users, planners and regulatory bodies in South Africa. The common programme to improve water-use efficiency is Water Conservation and Water Demand Management, and this programme will a have specific focus (**Chapter 8**) and will receive priority in the implementation plan, presented in **Chapter 16**.

Key WCWDM issues

- The National Water Act recognises the pivotal role of water conservation and water demand management (WCWDM) in water resource management, with the objective of enabling all user sectors to gain equitable access to the desired quantity, quality and reliability of water.
- WCWDM is the foremost Reconciliation Strategy to balance water supply and demand.
- WCWDM can be implemented in a shorter time than new infrastructure development and can significantly postpone the need for new water resources infrastructure and new water and wastewater treatment works.
- WCWDM is more cost effective than new water infrastructure development.
- WCWDM is important in the light of climate change when more frequent droughts and floods will impact adversely on the availability of water.

Development planning needs to be geared towards realisation of the water scarcity in South Africa and value of water for all the developmental needs. At present, water is not treated with high importance and as a priority. This is reflected in the manner in which water is poorly dealt with in the national and sector planning processes and budget allocations. There appears to be an assumption that water is readily available at minimal cost, resulting in ineffectual planning and unrealistic developmental expectations. Since the majority of the macro goals are water-resource related (from a supply and impact perspective), it is critical that water and its management are an integral part of the development planning and framework.

Steps to raise the water profile in development planning

- Water must be placed at the centre of integrated planning and decision-making, with a specific aim to respond to and support the achievement of national development and sector goals.
- Current budgets need to adequately provide for water, which might mean they have to be doubled to cater for the present needs.
- Current financial values need to appreciate water as a scarce resource and should thus reflect the real value of water. This requires a new value system across all sectors and stakeholders.
- Water efficiency and curbing water losses should be high on the agenda of each individual and institution in the country.
- Water management must be formally embedded in the sector businesses with associated accountability.

3.4 Principles and Approach

3.4.1 Developmental water management

This vision reflects and builds upon the principles of equity, environmental sustainability and efficiency that underpin the National Water Policy and National Water Act. The policy and legislation are founded on the principles of integrated water resources management (IWRM). However, within IWRM it is necessary to carefully interpret these principles within the context of a developmental state, and to recognise the linkages across the entire value chain from resource to tap and back to resource. This gives rise to the concept of developmental water management (DWM), which can be considered part of IWRM principle in practice and which takes, as a central premise, the fact water plays a critical role in equitable social and economic development, and that the developmental state has a critical role in ensuring that this takes place.

- To facilitate this vision and avert a potential water crisis, specific interventions must be achieved within the short to medium term.
- These interventions must be underpinned by the transformation of the sector into an effective and professional water business environment.
- Short- and medium-term interventions should not, however, foreclose future options, and the strategic balance between water-resource use and protection should be respected. The NWRS2 is the means by which this will be realised.

3.4.2 Alignment with international best practice and approaches

In developing the strategy, South Africa has sought to align with new and innovative concepts on new approaches to water management. The Rio+20 United Nations Conference on Sustainable Development, held in June 2012, provided a strong framework on which to base our approach to sustainable development and integrated water resource management.

Figure 4 illustrates South Africa's alignment with Rio+20.

What is "Rio plus 20"?

- At the Rio+20 Conference, world leaders, along with thousands of participants from the private sector, NGOs and other groups from more than 130 countries came together to shape how we can reduce poverty, advance social equity and ensure environmental protection on an ever-more crowded planet.
- Rio+20 provided a chance to move away from business-as-usual and to act to end poverty, address environmental destruction, build a green economy, achieve sustainable development and build a bridge to the sustainable future for people all over the world.

International Assessments 2012
WWF, Rio+20 Water Security Workshop

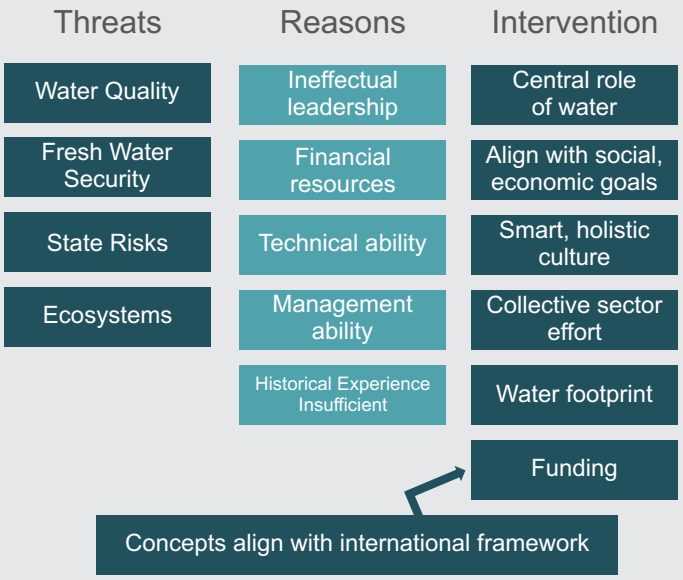


Figure 4: South Africa's alignment with Rio+20

3.4.3 Good governance

Governance in the water sector has political, administrative and economic dimensions and includes the activities of government as well as the interaction with water users and various stakeholders within the sector. Good water governance requires predictability, participation, transparency, equity, accountability, coherence, responsiveness, and integrated and ethical decision making. The following actions objectives and approach will be prioritised and adopted in the implementation of NWRS2:

- Establishment of an efficient institutional frameworkfor water management will be given urgent focus as a critical component for efficient water governance. The institutional arrangements and the roles of different institutions are discussed in **Chapter 8**.
- Clearly define mandates, roles and responsibilities to ensure that some functionality and accountability is maintained as it relates to local management of water by the relevant institutions and formations.
- Adopt adaptive management to ensure that changes can be made where sufficient progress towards the outcomes is not being achieved.
- Promote and implement a business approach model of management to ensure unsustainable water management does not translate into risks to human health, service delivery, the environment, employment and social and political stability.

This NWRS2 introduces four business principles that will form the foundation of sustainable water resources and infrastructure management:

1. Striving for efficiency from source to tap and back. This implies that the value chain from river or groundwater to wastewater should be considered in its entirety when making water-resource management decisions.
2. Implementation of life cycle planning and sustainable management of assets and services. This must be addressed through rigorous asset management and allocation of adequate funds.
3. Sustainable financial management. Clear decisions are needed on who should pay for what; and where and why transparent subsidising is to be used.
4. Applying sound management principles and practices within a developmental framework. This includes effective communication and consultation, ongoing investment in skills, capacity and education (short and longer term), as well as investment in knowledge, information and monitoring systems.

3.4.4 Partnerships with private and water use sectors

Stakeholder management and partnerships with all stakeholders within the water value chain is imperative. Neither government nor businesses alone can solve water issues such as climate change and water scarcity. As a result, government and companies increasingly have to forge new types of partnerships and rethink relationships with stakeholders. Sectors must become strategic partners, commit themselves to effective water resource planning, management and use, and accept accountability for water resource protection and associated actions.
Taking the lead from the UN-driven CEO Water Mandate and the experience of several large corporations in managing water risk, the private sector in South Africa has mobilised to manage water risk effectively.

Platforms to be used to facilitate dialogue between stakeholders and a common vision towards implementation of key actions of the NWRS2:

Strategic Water Partnership Network (SWPN) is an innovative partnership between the South African government and the private sector, launched by the DWA Minister, Mrs Edna Molewa (MP). It aims to enhance the coordination of efforts to close the water volume gap in the country by 2030.

Water Sector Leadership Group (WSLG) is a sector-wide strategic engagement led by the DWA. This is a forum for consultation on policy and key sector programmes.Provincial water sector forums are created to broaden participation, address water challenges, align plans and strengthen collaboration at the provincial level between all stakeholders in the water sector.

South Africa also has development treaties on cross-boundary water management and support arrangements with various funders and international agencies, which will be used to advance various aspects of support towards developmental water management. They will also be harnessed and sustained within the broader international relations portfolio, which is addressed in Chapter 9.

3.4.5 Participatory approach

Water management operates within a social, economic and ecological environment, and for effective and integrated management of water resources, top-down consultation should be replaced by citizens' participation, which will be facilitated through community forums and civil society organisation structures to achieve the required balance in the decision making process within a developmental water management agenda.

The Catchment management forums will be established and utilised to strengthen participation of communities and other stakeholders within a catchment management (see **Chapter9**).This approach will influence strategies to be adopted in ensuring sustainable management of water resources. The NDP supports active citizenry and emphasises that the state cannot act on behalf of the people – it has to act with the people, working with other institutions to provide opportunities for the advancement of all communities. This is a critical approach underpinning and supported in the NWRS2.

Rationale for citizen participation in NWRS2

- Water is to play an optimal role in poverty eradication and the reduction of inequality, growth and development, and in building a just and equitable society.
- Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.
- The participation of the poor is critical in eliminating poverty and ensuring the political legitimacy of policies and strategies.
- This participatory approach is fundamental in ensuring that development is localised and meaningful for ordinary citizens.
- The meaningful participation of communities will broaden the responsibility for effective and sustainable water resource management and serve to strengthen accountability from all.

South Africa's scarce water resource is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner to meet global obligations and to enable the national developmental goals towards a better life for all of its citizens.

3.5 Strategic themes

The strategic themes are the means towards achieving the objectives of the NWRS2. They address South Africa's economic and development priorities as well as the challenges that could impede the achievement of Vision 2030. The National Water Act requires the National Water Resource Strategy to *"... set out the strategies, objectives, plans guidelines and procedures of the Minister and institutional arrangements relating to the protection, use, development, conservation, management and control of water resources."* The strategic themes address these issues and respond to national priorities. These themes are explored in detail in the chapters that follow.

Theme 1:
Water resources planning, development and infrastructure management

To ensure well maintained and properly operated water supply infrastructure is available to meet the social, environmental and economic water use requirements of South Africa.

Theme 2:
Water resource protection

To ensure that South Africa's aquatic ecosystems are protected effectively at different and appropriate levels, and that decisions concerning levels of protection take transparent and just account of environmental, social and economic well-being.

Theme 3:
Equitable water allocation

To allocate water so that historically disadvantaged and poor South Africans enjoy access to water for productive economic purposes, or reap the benefits from water use to prosper socially and economically.

Theme 4:
Water conservation and water demand management

To achieve significant water savings by all sectors through the implementation of appropriate water conservation and water demand management measures to meet the social and economic needs of South Africa both now and in the future.

Theme 5:
Regulation

To improve the ability of the DWA to regulate the water sector in order to achieve the objectives of government, protect the resource and the consumer and ensure the sustainability of water institutions.

Theme 6:
Managing water resources for climate change

To plan and respond to a changing climate and its impact on the environment, water resources and the quality of life.

Theme 7:
International cooperation and trans-boundary water management

To advance the African agenda and to shape the global water agenda while ensuring that in South Africa, Integrated Water Resources Management (IWRM) is implemented in a manner that conforms to international water protocols and treaties as well as the legislative framework governing water.

3.6 Execution

Execution of the objectives and strategic themes takes place through the water sector as a whole (public sector, civil society and private sector) and is addressed in the chapters dealing with institutions, finance, monitoring and information, research and innovation, and sector skills and capacity.

Figure 5 provides an overview of the strategy from vision to execution. Core values and principles such as good governance, partnerships and participation cut across the entire strategy.

3.6.1 Key enabling factors to support execution

Enabling factor 1:
Institutional Arrangements
To ensure robust and sustainable water sector institutions that will:

- Ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons.
- Ensure and facilitate effective service delivery while supporting Government's transformational objectives.
- Contribute to Government's National Objectives and outcomes, as articulated in the National Development Plan (2012) and the National Programme of Action for 2010 - 2014.
- Serve the public effectively and loyally, carry out their responsibilities with integrity, transparency, energy and compassion through active co-operation, and contribute towards sustainable water management.

Enabling factor 2:
Financing the water sector
The focus is to achieve an optimal investment and ensure a financially sustainable water sector:

- Mobilise commitment for funding of sector projects by the public and private sectors.
- Ensure costs recovered through regulated water prices are pro-poor, reflect the economic value of water, promote water conservation and deter pollution.

Enabling factor 3:
Monitoring and information management
To achieve an integrated monitoring and information management system that supports sustainable water resource management:

- To enable assessment of the current state of the water body in terms of quantity and quality and their variability in space and time.
- To provide information needed for planning, decision making and operational water management at local, national and regional level and in critical situations, such as floods or droughts.

Enabling factor 4:
Research and innovation
Contribute towards providing of effective and efficient water management solutions that respond to the needs for water security and sustainability for individual communities, productive use, strategic water use and ecosystem services:

- Ensure that water research informs policy development and strategic decision making at all levels of government and across the water value chain.
- Provide knowledge and foresight on potential future challenges through research regarding climate change, population growth, energy consumption, changing economic conditions and political situations.

Enabling factor 5:
Skills and capacity building
To ensure an adequately capacitated sector with a pool of diverse skills to provide solutions and expertise in addressing all water sector challenges with a high level of competence for sustainable water resources:

- Develop capacity and skills to address all elements of water resource functions (protection, development, conservation, management and control).

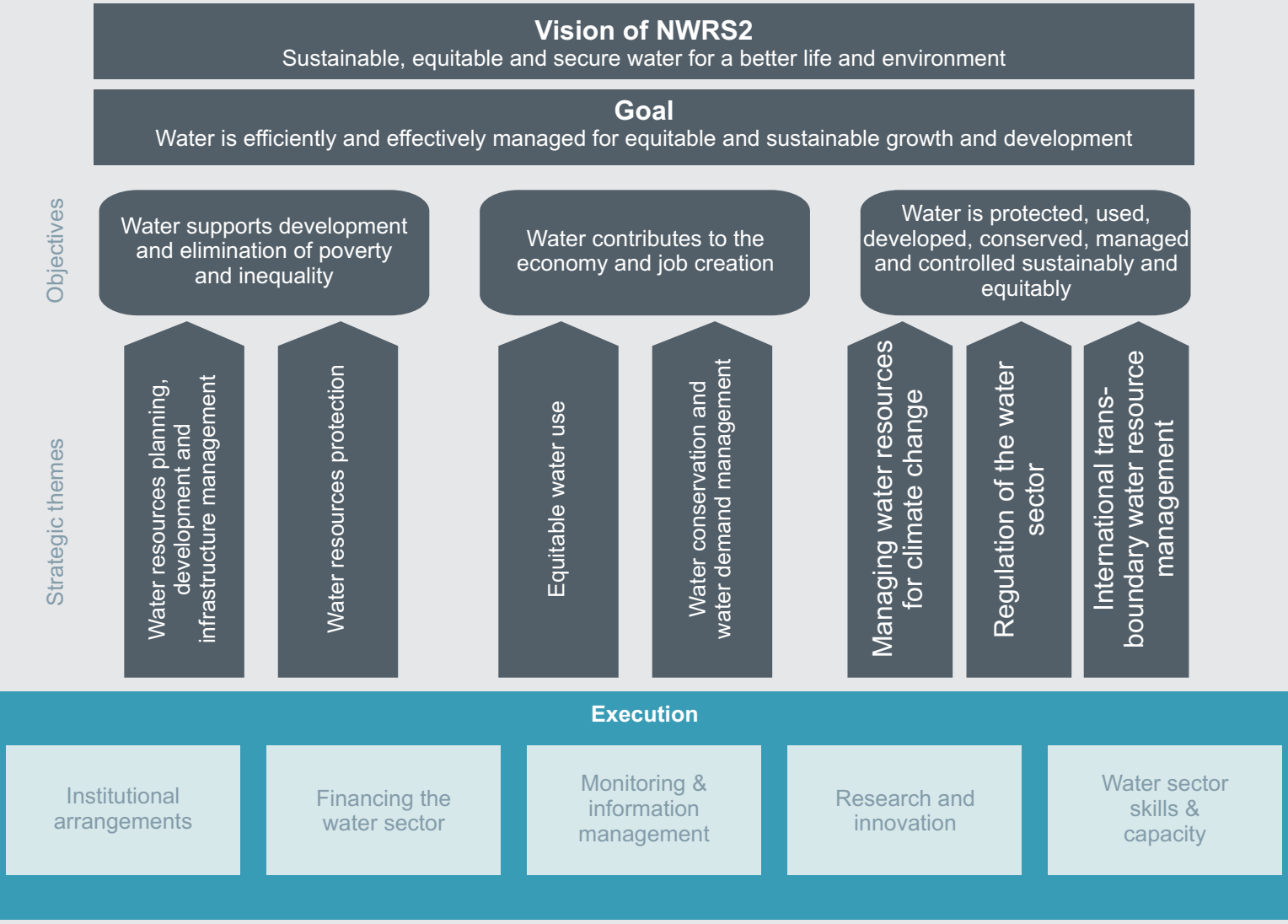


Figure 5: Overview of the NWRS2 Strategy from vision to execution

CHAPTER 4 WATER RESOURCES PLANNING, INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT

4.1 Context and current challenges

This section covers issues pertaining to the planning, development and management of water resource infrastructure, as well as the vision, objectives and strategic actions to make optimal use of infrastructure and to ensure a balance of water supply and demand.

4.1.1 Reconciliation of demand and supply

4.1.1.1 National water balance of NWRS1

Chapter 2 of the NWRS1 (2004) provided a high-level reconciliation of the requirements for and availability of water in 2000 for each of the then 19 water management areas and for the country as a whole. In 2000, the total volume of water available from the river systems in South Africa on a reliable basis, referred to as the yield, was estimated at 13 227 million m^3/a. The total local water requirements were estimated at 12 871 million m^3/a and 170 million m^3/a was being released or transferred out of South Africa to Botswana, Mozambique, Swaziland and Namibia. This implied that in 2000, a surplus still existed for the country as a whole.

4.1.1.2 Water mix

However, at that time, there were deficits in more than half of the water management areas. The implication was that there was no surplus water available for allocation in those water management areas. It is also not economically feasible to achieve a national balance by distributing all the surpluses to areas with shortages as pumping water over long distances is very expensive and a balance at national level is not a very meaningful concept.

The water balance developed in the NWRS1 showed that South Africa's surface water resources would be fully committed over the medium term and that a mix of water resources would be required to reconcile supply and demand. The broad strategies, or water mix, required to reconcile supply and demand listed in Chapter 2 of the NWRS1, were as follows:

- demand management
- water resource management
- managing groundwater resources
- re-use of water
- control of invasive alien vegetation
- re-allocation of water
- development of surface water resources
- inter-catchment transfers

The national water balances reported in the NWRS1 are still useful for providing a broad perspective on the water balance for each WMA and for the country. However, it is not sufficiently detailed to be a basis for infrastructure investment and management decisions.

The decision on the consolidation of the 19 WMAs into 9 new WMAs has also only recently been confirmed. Consequently, it was decided not to update the national and WMA water balance tables in the format produced in NWRS1 for this version of the NWRS, but rather to focus the limited available skills and resources on developing detailed water resource Reconciliation Strategies that are directed at meeting specific demands as a basis for water management and infrastructure planning.

The national water balance will again be produced in the following version of the NWRS.

4.1.1.3 Irrigation

The NWRS1 already indicated that additional water for an increase in irrigation would be very limited and was listed in Section 2.5.3 of the strategy . A detailed survey conducted by the Department in 2006 and updated recently, indicates that about 80 000 ha of additional irrigation could be developed, based on currently available surface water resources. Most of this is in the high rainfall areas along the east coast of the country, either from existing dams or from run-of-river.

It is possible to extend this by building dams in these high rainfall areas, but this will be costly and proposed schemes will have to be carefully planned and considered before being implemented.

A feasibility study for a dam on the Mzimvubu River is currently underway.

4.1.1.4 Reconciliation Strategies

To build on the overview statistics of the water balances given in NWRS1 and to address the detailed planning needs, Reconciliation Strategies have been developed to inform water resource investment and management decisions for:

- Large systems supplying areas of major economic importance
- Specific cities and towns not included in the large systems but addressed in the All Town Studies
- The large system Reconciliation Strategies are informed by:
- Future water requirement scenarios developed in consultation with users taking account of all the drivers of water requirement growth like population growth, increase of levels of services over time, economic growth scenarios as expressed in Provincial Growth and Development Strategies, and IDPs, growth in mining and electricity generation, where applicable
- Investigations of all possible water resources and other interventions that could increase water availability
- Evaluation of all possible methods for reconciling requirements with the available resources
- Recommendations for development and implementation of interventions

Planning for further resource development focuses on high-growth scenarios for future water requirements over, for example, 25 years; the principle being that implementation usually takes place in phases, and later phases can be scheduled to match actual growth in water requirements. The reason for choosing the high growth scenario is that it is very difficult, if at all possible, to bring a reconciliation phase forward in time if the growth in water requirements was significantly underestimated. However, it is relatively easy to delay the next phase.

The availability of water is estimated using sophisticated techniques for analysing and interpreting the extensive body of hydrological information available in South Africa. These techniques are supported by world-class mathematical models capable of representing even the most complex of our water resource systems. Of particular importance is the analytical capability to account for the large variability in hydrological conditions in South Africa, as reflected in the range and changeability of climatic conditions across the country, as well as the possible impacts of climate change. A powerful attribute of these planning tools is the ability to model combinations of future growth and hydrological conditions in a large river system using probabilistic approaches. In this way the risk of unacceptable shortfalls occurring, with significant social and economic consequences, can be minimised.

Water quality is a fundamental consideration in water resource management. Reconciliation Strategies are thus directed towards ensuring that water supplies meet the realistic quality requirements of the intended users. The main sources of pollution that have a negative impact on water quality are:

- discharges of urban and industrial effluents to the environment
- irrigation return flowswith high salinity concentrations
- wash off and leachate from mining operations
- wash off from areas of human settlement with inadequate sanitation

Most water quality problems caused by these sources of pollution can and should be solved at source.

Reconciliation Strategies have been completed for the following large systems shown in **Figure 6:**

- Western Cape
- Amatole
- Vaal River
- Crocodile West River
- KwaZulu-Natal Coastal Metropolitan areas
- Algoa
- Mangaung Metropolitan area
- Olifants River (Mpumalanga)

The following Reconciliation Strategies are in progress:

- Luvuvhu-Letaba River system
- Orange River system
- Mbombela area
- Richards Bay area

Strategy Steering Committees have been established for each system and area to monitor implementation, to update the strategies and to communicate about the strategies. Members of the Strategy Steering Committees include representatives of the DWA, provincial government, municipalities, CMAs, water boards, Water User Associations and other user groups. Information concerning the strategies is updated on a continuous basis and informs, among other things, the Water Sector Infrastructure Investment Framework.

Updated information on each strategy is available on the DWA website at www.dwa.gov.za/projects.aspx

Table 5 summarises the water balance for each large system Reconciliation Strategy.

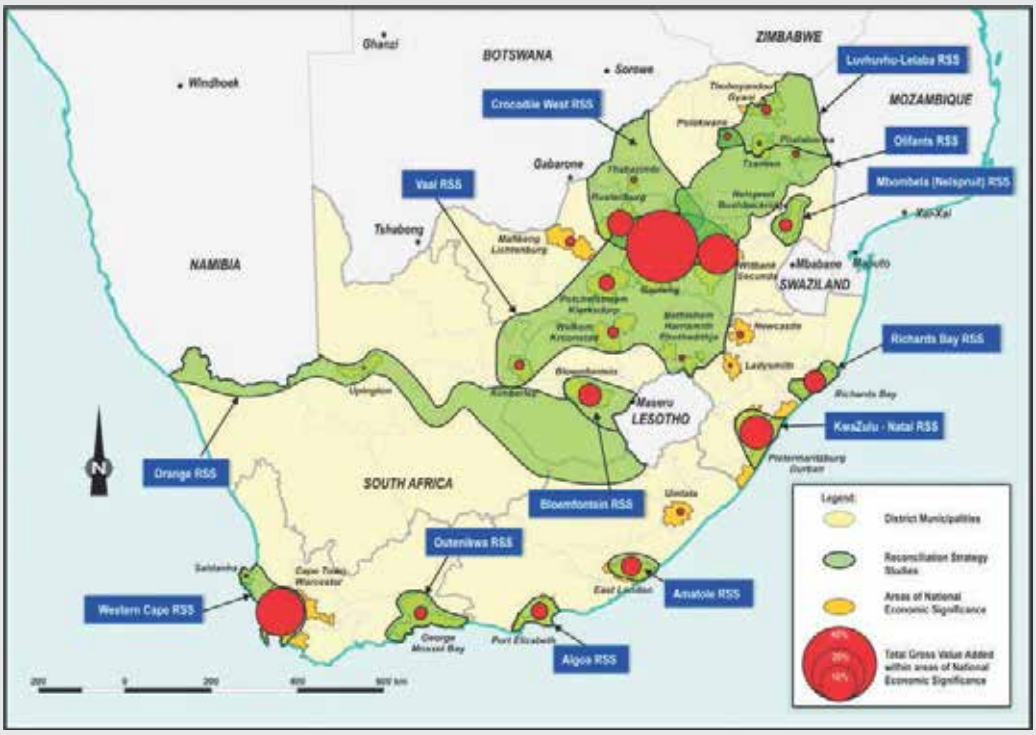


Figure 6: Systems for which reconciliation strategies are prepared

Table 4 shows that the high level summary of all the Reconciliation Strategies confirms the water mix already given in the NWRS1 and has now added the large-scale desalination of seawater as an important additional resource in the mix.

The key strategic messages flowing from the detailed Reconciliation Strategies can be summarised as follows:

- WCWDM is extremely important in all areas. South Africa cannot afford to waste any more water, anywhere.
- Groundwater is important, is currently under-valued and is under-used.
- There is huge potential for increasing re-use of waste water, at the coast as well as in inland systems.
- There is limited opportunity for more dams and transfer schemes, but this option is inevitable in certain areas; however, at great cost.
- Desalination:
  - Small-scale seawater desalination is already being used in certain areas
  - Mine water desalination is becoming more important
  - Desalination of seawater on a large scale is imminent
- Catchment rehabilitation, clearing of invasive alien plants and rainwater harvesting is growing in importance.
- It is possible to make more water available anywhere in the country in the future, but at sharply rising costs.
- The cost of water at the coast will, over the long term, increase and approach the cost of the desalination of seawater. However, it will be very expensive to support the inland areas with desalinated seawater as this option will require significant transfer costs. Thus, the allocation of water from the remaining large inland resources like the Upper-Thukela and the Orange River will have to be reserved for the economic heartland of South Africa that is supplied from the Vaal River system.
- Additional water for increasing irrigation in South Africa is very limited and moving some water from irrigation to other uses is already be considered in certain areas. Irrigation development has been very slow since NWRS1 due to the unavailability of water at an affordable cost.
- There is a debate about virtual water and importing food from neighbouring countries with high food production. The potential for this option must be broadened. No water should be used to produce bio-fuels under irrigation.

Table 4: Water balance for each large System Reconciliation Strategy (Year 2030)
(All figures in million m^3/a)

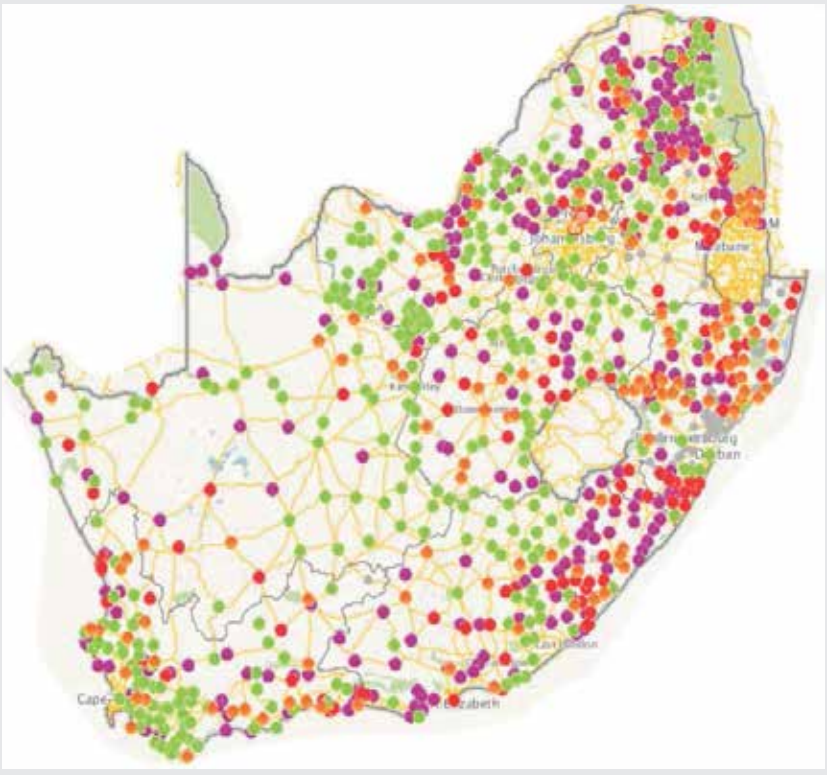
Supply system	Currently available water resource yield (2012)	2012 total water requirements Note 3	2012 balance	WCWDM targets (volume and date)	Date at which high growth requirement will exceed current resource	2035 High water requirement scenario Note 3	Drivers for growth in requirement	Additional water required before 2035	Measures available to supply additional water
					WCWDM in place				
1.Western Cape Greater Cape Town, West Coast towns and irrigation	580	513	67	90 (2017)	2019	950	High population growth due to high in-migration and increased service levels	370	•Surface water: 80 •Reuse of water: 130 •Groundwater: 50 •Desalination: 110
2.Algoa NMBM, surrounding towns and Gamtoos Irrigation Board	170	170	0	15 (2015)	2012	240	High population growth High economic growth – Coega IDZ	70	•Complete Nooitgedagt LLS: 25 •Reuse of water: 35 •Groundwater: 30 •Desalination of Lower Sundays River return flows: 10
3.Amatole Buffalo City, and surrounding towns	108	85	23	10 (2015)	2025	120	Population growth	12	•Reuse of water: 30 •Surface water: 10+ •Desalination
4. KwaZulu-Natal coastal metropolitan area Supplied from the Mgeni, Mhloti, Mvoti and Thukela river systems	375	440	-65	40 (2018)	Already exceeded in 2005	600	Urban growth and improved standards of living (upgraded service levels)	226	•Spring Grove Dam: 60 •Hazelmere Raising: 9 •Lower Thukela BWS Ph 1 and Ph 2: 40 •Mvoti Rover Development: 28 •Reuse: 40+ •Mkomazi River Development: 150 or Desalination of sea water: (unlimited)

Supply system	Currently available water resource yield (2012)	2012 total water requirements Note 3	2012 balance	WCWDM targets (volume and date)	Date at which high growth requirement will exceed current resource	2035 High water requirement scenario Note 3	Drivers for growth in requirement	Additional water required before 2035	Measures available to supply additional water
					WCWDM in place				
5.Vaal River	3000	3000	0	209 (2015) Note 4	2015	3229	(I) Population growth and migration to Gauteng (ii) Economic growth	229	•Desalination and use of AMD water. Note that if this is not done, the yield will drop by about 500 million m3/a between 2015 and 2020. •LHWP Phase 2 without additional storage in Orange
6.Crocodile West Northern areas of Gauteng, platinum mines, developments around Rustenburg, Brits and further north to Thabazimbi & energy-related developments in Waterberg coalfields near Lephalale	109	1045	45	65 by 2015	2022 (with transfer to Lephalale included) and growing local resource due to return flows	1405	Urbanisation/ population migration and economic growth in crocodile. Mining and power generation in Lephalale	315	•Additional transfer from Vaal River into the Rand Water supply area in Northern Gauteng: 200 •Additional return flows generated form North Gauteng: 100 •Temporary hiring of small volumes from exiting users to cover small short duration deficits may be required after 2022
7.Olifants River The entire Olifants Water Management Area and the adjacent areas of Polokwane and Mogalakwena, which are supplied from the Olifants	1023	1036 note 5	-13	51 (2023)	2013	1179 Note 5	Increased mining and associated urban growth	156	•Groundwater: 35 •Alien Invasive Plants (AIP) Removal: 11 •De Hoop Dam: 99 •Excess Mine Water: 22 •Reuse: 11
8.Mangaung Metropolitan area	84	84	0	11 by 2016	2013	168	•Population growth and migration to Mangaung •Economic growth •Improved Service Deliver	85	•Increase Tienfontein pumping: 5 •Improve Welbedacht WTP's ability to handle high turbidity levels: 8 •Augment Knellpoort Dam from Caledon (Welbedacht P/S: 20 •Further increase in Tienfontein Pumping Capacity: 18 •Water reuse: 11 •Augmentation from Orange (Gariep Dam): 30 Note 6

Supply system	Currently available water resource yield (2012)	2012 total water requirements Note 3	2012 balance	WCWDM targets (volume and date)	Date at which high growth requirement will exceed current resource	2035 High water requirement scenario Note 3	Drivers for growth in requirement	Additional water required before 2035	Measures available to supply additional water
					WCWDM in place				
9.Western Cape Greater Cape Town, West Coast towns and irrigation	57	55	2	9 by 2018	2014	74	•Urban growth and improved standards of living •New university	17	•Pending water use license conversions:4 •Groundwater development: 2 •Removal of Alien Invasive plants: 5 •Water re-allocation: 5 •Dam development: 20 to 60
10.Algoa NMBM, surrounding towns and Gamtoos Irrigation Board	3320	3320 Note 7	0 Note 8	40 by 2018	2022	3755	•Urban/ Industry •Resource poor farmers •Transfer to Vaal •EWR	435	•Improved operation: 80 •Vioolsdrift Dam (final size and yield still to be determined) •Bosberg Dam (size and yield still to be determined)

Notes:

1 *The water requirements for the various supply systems are not mutually exclusive and should not be added together to obtain an overall perspective.*
2 *The figures provided in this table are a summary and are continuously being updated. The Reconciliation Strategy should be viewed on the DWA web site for a more comprehensive explanation and for the latest figures.*
3 *Includes ±400 million m3/a for ecological water requirements(EWR)*
4 *Includes the eradication of unlawful use.*
5 *Total ecological reserve component (157 million m3/a) was included in the 2035 water requirement scenario.*
6 *All increase in yield from the Caledon is based on effective scouring in Welbedacht Dam.*
7 *The 2012 Orange requirement includes the allocation for resource poor farmers (12 000 ha) although very little of this has already been developed and used, as well as for the Nooitgedacht Low Level Scheme in the Port Elizabeth.*
8 *These balance figures are preliminary and will be firmed up by the Orange Reconciliation Strategy Study that is in process.*



Legend

	Category	Count of Towns	% of Towns
	no shortage >10 yrs	334	37%
	water resource shortage 5-10 yrs	113	12%
	water resource shortage 1-5 yrs	120	13%
	water resource currently in deficit	273	30%
	unknown	65	7%
	Grand Total	905	100%

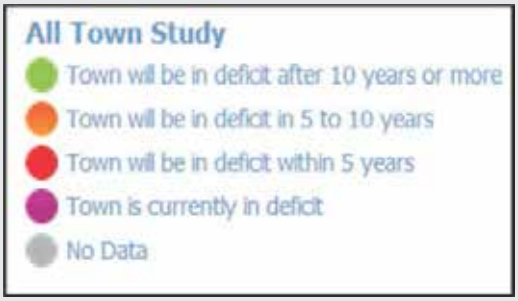


Figure 7: Water Reconciliation - All Towns

It is possible for South Africa to enjoy water security, however:

- Water management is complex and involves the whole water sector.
- Implementation will be the key and the water sector needs.
- More financial resources are required.
- Fully functioning institutions with appropriate human resources are essential.

However, unpopular decisions will have to be made upon occasion.

Key messages from the All Town Studies

The All Town Studies showed that, in most cases, water supply deficits are not the result of water resource shortages but rather of poor water supply management. Improved management will solve most of the immediate problems. Typical water management problems are:

- A lack of metering information, resulting in WSAs having limited information on how much water is used or wasted
- A large wastage of water
- Per capita use, which is much too high
- Free water being provided far above the indigent level obligations
- Poor cost recovery
- Lack of proper maintenance and skilled operators
- Low technical competency

The All Town Studies also showed that groundwater is a very important resource for towns. The water resource situation for all towns is shown in **Figure 7,** which indicates that 30% of towns are currently in deficit and therefor require immediate intervention.

4.1.2 Planning for urban development

More than half of the South African population currently lives and works in urban areas, which are growing at approximately 5% per annum. Some 80% of the Gross Domestic Product is produced in our cities and towns. Their well-being is thus vital to the national economy, to meeting the basic needs of the poor and to sustaining our environment.

Guided by the basic tenets of the Reconstruction and Development Programme (RDP), the Department of Human Settlements (DHS) has developed an Urban Development Framework (UDF) that strives to outline the urban initiatives necessary to give substance to the imperatives outlined in the Growth, Employment and Redistribution Strategy and relevant other development programmes and strategies

Given the importance of cities and towns, water resource and water services planning will be aligned with the vision expressed in the Urban Development Framework to support the development of urban settlements that will be:

- Spatially and socio-economically integrated, free of racial and gender discrimination and segregation, enabling people to make residential and employment choices to pursue their ideals.
- Leaders of a robust national economy as well as economically competitive internationally.
- Centres of economic and social opportunity where people can live and work in safety and peace.
- Centres of vibrant urban governance, managed by democratic, efficient, sustainable and accountable metropolitan and local governments in close cooperation with civil society and geared towards innovative community-led development.
- Environmentally sustainable, marked by a balance between quality built environment and open space; as well as a balance between consumption needs and renewable and non-renewable resources.
- Planned for in a highly participative fashion that promotes the integration and sustainability of urban environments.
- Marked by good housing, infrastructure and effective services for households and business as the bases for an equitable standard of living.
- Integrated industrial, commercial, residential, information and educational centres that provide easy access to a range of urban resources.
- Financed by government subsidies and by mobilising additional resources through partnerships, more forceful tapping of capital markets, and via off-budget methods.

4.1.3 Multiple use planning

A significant challenge in water resource planning is to ensure a smooth integration of the provision of water supplies for domestic use and water for other purposes leading to economic production, particularly in rural areas. Water for domestic supplies in rural areas is used for various household purposes such as cooking, washing, food gardening, stock watering and small businesses. If water is provided mainly for irrigation, it will also be used for domestic purposes, and if water is provided for domestic purposes, it will also be used for other purposes

The DWA has developed a Social Assessment and Development Framework and a set of implementation guidelines to better integrate social needs into the planning of new water resource infrastructure. The framework ensures that all new water infrastructure is planned, developed and used as multi-purpose facilities, especially to meet social needs. However, this approach has not yet been followed through to integrate the planning done by municipalities and the DWA to ensure that water supplies provided for domestic use also serve productive uses.

A new approach to planning for community water supplies is required; one that considers and provides for the multiple water needs of the community. This may necessitate using water from a range of different sources. Policies are in place to facilitate cooperation between the DWA and local government in planning and developing multi-purpose water supplies for communities. The DWA intends to engage more closely with municipalities to implement this approach, using the Interim Water Supply Programme (IWSP), RBIG and the Municipal Infrastructure Grant (MIG) sources of funding to address the multiple water use needs of poor rural communities.

4.1.4 Potential sources of water

To make sufficient water of an appropriate quality available for the socio-economic needs of the country, while still ensuring that the health of aquatic ecosystems is protected, all of the water resources described in this section must be harnessed effectively, particularly in already highly stressed catchments. In addition, water conservation and water demand management is a critical element of the water resource development strategy.

4.1.4.1 Development of surface water resources and transfer of water

The DWA is overseeing the implementation of 151 water resource development projects, including projects carried out by the TCTA and the water boards. Seven major water projects will be completed around the country by 2014.

Implementation of Phase II of the Lesotho Highlands Water Project has been approved and is planned to deliver water to Gauteng by 2020. A number of water resource development projects focusing primarily on social development and on water security have been initiated, such as the proposed Nwamitwa Dam in the Groot Letaba River, near Tzaneen in the Limpopo Province, and a storage dam at a site still to be confirmed in the Mzimvubu River catchment in the Eastern Cape.

However, under-investment in water resource infrastructure, including under-investment by municipalities in wastewater treatment works, is a cause for concern.

A list of large water resource development projects in different phases of the project cycle is given at the end of this Chapter.

4.1.4.2 Groundwater development and management

The DWA completed the first detailed National Groundwater Strategy (NGS) for South Africa, including an Artificial Recharge Strategy in February 2011, following a three-year consultative process.

Groundwater is the primary source of reliable, safe drinking water supplies in rural areas and for many towns in South Africa; for the irrigation of thousands of hectares of valuable arable land around the country; and for supporting large numbers of livestock and game. Many mines and industries also rely on groundwater for their supplies.

Artificial recharge, the process whereby surplus surface water is transferred underground to be stored in an aquifer for later abstraction and use, is growing in importance in South Africa and internationally. The most common recharge methods used involve injecting water into boreholes and transferring water into spreading basins where it infiltrates the soil subsurface and percolates down into the groundwater. Underground water storage is efficient in that the reserves are not vulnerable to evaporation losses and are relatively safe from contamination.

However, groundwater is still under-utilised and the following issues must be addressed:

- Groundwater is often not recognised as a valuable resource by land use planners and by municipalities, resulting in poor coordination between groundwater development and the use of land for human settlements and for other purposes.
- There is a backlog in license applications for the use of groundwater, resulting in water use without proper regulation and monitoring.
- Enforcement of water use licensing conditions is weak.
- There is no verification of existing lawful groundwater use, making effective regulation difficult.
- Groundwater pollution from sources, such as acid mine drainage (AMD) and poor sanitation is not being addressed effectively.
- Regulatory oversight of groundwater is inadequate.

4.1.4.3 Water re-use

Re-use of water is becoming more acceptable and feasible because of increasing water shortages, improved purification technology and decreasing treatment costs. Improvements in membrane technologies and their affordability have made a significant contribution in recent years.

At present, up to 14% of water use is reused, mostly through wastewater return flows to rivers from which it is abstracted downstream for indirect re-use. Re-use of return flows could be significantly increased, particularly in coastal cities where wastewater ordinarily drains into the sea.

Pre-feasibility investigations of direct re-use opportunities are underway for a total of about 280 million m^3/a while initial studies for an additional 15 million m^3/a have been commissioned.

Water re-use projects typically involve a range of activities that are subject to regulatory authorisation and control. These controls include provisions in:

- National Water Act (Act 36 of 1998)
- Mineral and Petroleum Resources Development Act (Act 28 of 2002)
- National Environmental Management Act (Act 107 of 1998)
- National Environmental Management: Waste Act (Act 59 of 2008)
- Water Services Act (Act 108 of 1997)
- National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008)
- Municipal bylaws

The direct re-use of treated wastewater can pose a risk to public health and safety; must be managed carefully and be subject to water quality management and control. Advanced treatment technologies, sufficient operating capacity and proper monitoring of all processes and quality of potable water produced is essential.

Public perceptions and opinions vary on the topic of water re-use, specifically as it relates to direct potable water re-use. Public perceptions are strongly informed by the general awareness of the poor operation, maintenance and performance of municipal wastewater treatment plants at present. This poses a significant challenge to building public acceptance of direct water re-use in the current situation. The performance of municipal wastewater and effluent treatment plants nationwide will have to be improved to meet high standards, resulting in consistently good quality discharges to the environment before direct water re-use can be placed on the national water supply agenda (see **Annexure D**).

4.1.4.4 Desalination of seawater

Desalination of seawater could provide an unlimited resource of fresh water, especially in coastal areas. However, while the costs of desalination technology are decreasing, the escalating cost of energy is a concern, particularly because desalination requires large amounts of energy(see **Annexure C**).

4.1.4.5 Management of acid mine drainage

The problems associated with AMD result largely from an era, prior to the National Water Act and the National Environmental Management Act, when control over mining impacts and closure of mines was far less stringent than they are now. While the pollution from AMD is a significant problem, the potential increase in water availability from treated AMD offers opportunities for making additional water available to supplement traditional water resources.

The additional water comes from changes in run-off and infiltration patterns in heavily mined catchments, which appears to have increased yield in these areas. However, the quantity of additional water that can safely and reliably be made available from this source has yet to be confirmed.

Whether additional water becomes available or not, the AMD must be managed and treated and the polluter-pays principle must apply where mines still have an identifiable owner. The challenge lies in putting reliable institutional arrangements in place that will continue to treat the water even after the mines have closed down.

The DWA is currently investing in the treatment of AMD emanating from various aquifers in the Vaal River Catchment and the opportunities for doing the same for drainage from coal mines in the Witbank area and in the Olifants River Catchment, all of which is intended for re-use.

4.1.4.6 Water harvesting

The DWA supports a national water harvesting programme (rainwater and fog harvesting), which, at present, has a narrow but important focus on the provision of above- and below-ground water storage tanks for rural households and other institutions such as clinics, schools and hospitals. While the collected water is intended for irrigation of food gardens to improve food sufficiency and for other productive water uses, this water will also be used for domestic purposes where communities do not have a reliable source of potable water.

Several municipalities have experience with the use of tanks for collecting rainwater for domestic use from roofs of houses, as well as for fog harvesting. These facilities have been found to be particularly effective when used in conjunction with other water supply options. For example, eThekwini Municipality piloted rainwater harvesting to supplement the water supply to 500 poor households in Inanda, Ntuzuma and KwaMashu and managed to save 10% on bulk water demand.

Although the potential extent of this resource has not yet been reliably estimated, it is an option that can be implemented relatively quickly. Capital costs can be relatively high for the small yields that are possible but, in many circumstances, rainfall harvesting for household use could make a significant difference to the quality of life of many people.

4.1.4.7 Importation of water intensive goods

An opportunity for decreasing the stress on South African water resources is to import water-intensive goods such as agricultural crops from other countries where the availability of water for irrigation is not a limiting factor. This opportunity brings with it significant socio-economic consequences such as:

- Associated loss of work opportunities in agriculture and downstream economic activities
- Implications for national food security

However, it frees up water for other purposes within the country.

The DWA has undertaken a study of the potential for crop production in neighbouring countries which shows that, in terms of physical production factors such as soils and climate, the potential is high. This approach is aligned with the goal of regional economic integration in the Southern African Development Community (SADC).

4.1.5 Infrastructure development, operation and maintenance

South Africa has relatively well developed water resources and water services infrastructure, but there are a number of challenges pertaining to the maintenance and refurbishment of infrastructure, the costs of construction, and the costs of maintenance. Effective asset management must be addressed to ensure the sustainability of the infrastructure and to reduce water loss from poorly maintained infrastructure.

4.1.5.1 Appropriate technology and value engineering

The cost effectiveness of some large investments in the water sector and the appropriateness of the technology used in some circumstances are concerns. Real examples of situations that give cause for concern are complex water treatment works that have been built for rural municipalities who do not have the technical capacity to manage these works. Similarly, some poor communities have been burdened with energy-intensive water supply systems and schemes with under-utilised capacity. The life-cycle costs of such schemes have not been fully budgeted for and are unaffordable for the communities.

In future, the DWA will insist that all water infrastructure it funds is value engineered against the life-cycle cost with a specific emphasis on energy costs. Evidence will be required that the technical design is appropriate for the nature of the resource and that operation and maintenance of the assets is reasonably within the capability of the responsible institution.

4.1.5.2 Functionality and infrastructure asset management

Many dams and associated water resources infrastructure components were built more than 40 years ago. While the main concrete and heavy steel structures may have an extremely long functional life, spillways, gates, pumps, pipelines and canals and associated equipment need regular maintenance and occasional major refurbishment to ensure safe and reliable operating capability over extended periods.

The DWA has developed an Infrastructure Asset Management Policy for its Water Trading Entity and has implemented a Dam Safety Rehabilitation Programme. So far,18 major Departmental dams have been rehabilitated.

Extensive irrigation areas are frequently supplied out of long canal systems that need refurbishment. Inadequate repairs and maintenance result in unacceptable water losses, mainly through leakage. In some cases, more than 60% of the available water is lost. Many of these canals are extremely long, some more than 200 km long. Since 2007, the DWA has rehabilitated 24 canals. However, under-investment in the refurbishment of State-owned water resource infrastructure has resulted in a backlog of work with an estimated cost, at today's value, of R14 billion. There is also a considerable backlog in the rehabilitation of water infrastructure owned by water user associations and municipalities.

The physical condition, general state of repair and capacity to consistently operate at design levels of service of municipal water treatment works and wastewater treatment works are a cause for concern. A number of treatment works are in a state of disrepair and many do not have sufficient capacity to meet the specified minimum potable or wastewater quality standards. The measured performance of municipal treatment works are reflected in the Green Drop and Blue Drop reports.

4.1.5.3 Water resource systems operations

Water requirements in all user sectors are increasing, in general, while the opportunities for augmenting supplies to meet these needs diminish. Water supply systems comprising a number of interlinked sources, with major storage dams and interlinking aqueducts and pumping installations, are becoming very complex. It is thus important to operate the water resources infrastructure optimally to meet sometimes conflicting requirements and to reduce water wastage in the system.

Operating rules for water resources infrastructure comprise comprehensive instructions, based on the state of storage and river flow at critical points in the system and on water requirements at various abstraction points, for releasing water from storage, starting and stopping pumping stations and opening and closing abstraction works of individual or groups of users. In a number of cases, formal operating rules for important water resource systems have not been properly documented and implemented. This situation could deteriorate as responsibility for the operation and management of water supply infrastructure is transferred to water boards, water user associations and municipalities that do not have access to the necessary expertise and human resource capacity.

The DWA developed Guidelines for Water Supply Systems Operation and Management Plans during Normal and Drought Conditions in October 2006. The DWA has developed formal operating rules for a number of water supply systems in South Africa, such as the Integrated Vaal River System, the Orange River System, the Algoa System, the Amatole System, the Western Cape System and the Groot Letaba System. It also developed a Disaster Management Plan and a Guideline to Flood Management.

The important features of operating rules for complex river systems are:

- Resource and infrastructure configurations
- Short- and medium-term water availability
- Water requirement schedules at all abstraction points
- Specific or customised Operating Decision Support System
- Annual operating rules (an operating protocol for the specific hydrological year)
- Information from monitoring systems
- An early warning system
- Specified "decision month" in which the water budget is presented to stakeholders
- Institutional and communication arrangements, which include the Stakeholder Operating Forum

Operating rules also provide for monitoring and auditing of the assumptions under which the annual operating rules were developed and include:

- Maintenance of proper records regarding resource levels, quality trends, abstractions, reserve compliance, returns flows and compliance with restrictions (when relevant)
- Records of the physical condition of the infrastructure and performance of the system
- Appropriate feedback indicating where actions are required

4.1.5.4 Multipurpose use of infrastructure
Aquaculture
The DWA has developed a policy for the use of water stored in major dams for aquaculture purposes, although very few aquaculture projects have been implemented to date.

Hydropower generation
Eskom owns large hydro-electric power stations at the Gariep and Vanderkloof dams on the Orange River, as well as smaller power stations at Colley Wobbles on the Mbashe River, First Falls on the Umtata River, Ncora on the Ncora River, and Second Falls on the Umtata River. The total installed generating capacity of these stations is approximately 660 MW.

Independent power producers generate hydro-electricity at a number of small power stations, the most significant of which are at Clanwilliam Dam in the Western Cape and at Bethlehem in the Free State, where water flowing from the Lesotho Highlands Water Project is utilised.
Hydro-electricity is also produced in Lesotho at Muela using the flow of water transferred by the Lesotho Highlands Water Project into South Africa.

Eskom owns large pumped-storage hydro-electric power stations at the Drakensberg, near Bergville, KwaZulu-Natal (1000 MW installed capacity) and at Palmiet near Grabouw, Western Cape (400 MW installed capacity), which are used primarily for meeting peak energy demands and for maintaining system stability on the long transmission lines in the national electricity network. The new Ingula Pumped Storage Hydro-electric Power Station, with installed capacity 1000MW, is nearing completion near Ladysmith in KwaZulu-Natal.

Hydropower is one of the renewable sources for generating electricity referred to in the Integrated Resource Plan 2010 (IRP 2010) for developing South Africa's electricity generation capability to meet expected energy demands up to 2030. Development of renewable energy sources, rather than burning fossil fuels such as coal, will contribute to the reduction of carbon emissions, while also ensuring sufficient energy to support growth in the economy.

There are significant opportunities for generating renewable energy across the country, including wind farms, concentrated solar power, photo voltaic panels, bio mass and hydro-electricity. The National Development Plan requires that more than 20 000 MW of renewable energy will be contracted by 2030, including an increasing share from regional hydro-electricity.

The installation of small-scale hydro-electric plants to take advantage of the head available and the flow from existing dams is being considered in cooperation with the Department of Environmental Affairs (DEA), National Treasury, Eskom, the Central Energy Fund and private sector partners.

4.1.5.5 Ownership of infrastructure
The ownership of state-funded or built water-resource infrastructure for serving public needs will always rest with an organ of state (National Government, a municipality, a water board, a wateruser association (WUA), or a catchment management agency (CMA)). Various funding arrangements can be used for constructing and managing this infrastructure, but this does not affect the ownership status. This is separate from privately funded and owned dams such as farms dams.

Ownership of national water resource infrastructure, or the infrastructure components of an interconnected system or infrastructure of strategic importance, will always be under the direct control of the Minister.

Bulk and regional water infrastructure will generally be under the control of a regional water utility, while irrigation schemes will be under the control of a WUA. Local water resource infrastructure can be under the control of a municipality where the municipality has the capability of maintaining the asset and ensuring the safety of dams. Otherwise, ownership and responsibility for local water resource infrastructure, especially dams posing a safety risk, will be transferred to a water board.

4.1.6 Job creation
A critical aspect of infrastructure development is the obligation and commitment to create jobs. Direct job creation takes place through the development, operation and management of water infrastructure, while indirect job creation flows from the associated water supplies to economic activities such as mining, manufacturing, power generation and agriculture.

Investment in infrastructure development could create employment for local workers and provide skills development and work experience at a number of levels, from the highly technical jobs to manual labour, particularly where labour-intensive construction methods are used. The operation and management of water infrastructure also offers opportunities for job creation.

4.2 Principles

The principles are that:

- New water resources infrastructure will not be developed or authorised unless effective water conservation and water demand management interventions have been put in place in the affected area.
- Water resource infrastructure development is based on sound strategies for reconciling realistic water requirements with appropriate supplies, developed after consultation with relevant stakeholders and user groups.

- Groundwater, water reuse, desalination, treated acid mine drainage, rainwater harvesting and water conservation and demand management interventions are, together with surface water resources, recognised and utilised as integral components of South Africa's water resource Reconciliation Strategies.
- Water infrastructure planning is aligned with vision expressed in the Urban Development Framework in support of South Africa's cities and towns meeting the needs of our growing population for shelter, economic, social and environmental development.
- Water infrastructure is developed for multi-purpose use and poor communities in the vicinity of state-owned infrastructure must benefit from that infrastructure.
- Water infrastructure planning considers the multiple use needs of communities.
- Investment in water infrastructure is cost effective and produces value for money on a sustainable basis.
- Water infrastructure development, operation and maintenance is used as a vehicle for job creation and for supporting equitable socio-economic development.
- All water infrastructure is properly operated and maintained.
- Planning for water resource development and for water supply, including design, construction, operation, maintenance and management of water infrastructure, takes full account of the possible consequences of climate change.
- Opportunities for developing the hydro-electric potential of the country are promoted wherever viable.

4.3 Objectives

- **Water Reconciliation Strategies:** Develop, update and maintain water Reconciliation Strategies for all water resource systems and towns under stress.
- **Infrastructure investment plan:** Maintain a long-term capital investment plan for developing water resource infrastructure that is based on up-to-date reconciliation of changing water requirements and water availability from surface water, groundwater, re-use, desalination of seawater and rainwater harvesting sources.
- **Hydroelectricity generation:** Promote the optimal development of hydro-electricity generation at all sites in South Africa where this is economically viable and can make a useful contribution to electricity generation.
- **Value engineering:** Ensure that capital investment in all water infrastructure is cost effective, the facilities are fit for purpose and value for money is maximised.
- **Operation and maintenance of assets:** Ensure that dams and water supply systems are operated, maintained and refurbished according to formal rules and guidelines.
- **Planning for Urban Development**: Ensure that water supply planning is aligned with government's vision for the development of cities and towns, as expressed in the Urban Development Framework.
- **Multi-purpose dams:** Use water resource infrastructure, particularly major storage dams, for multi-purposes to serve multi-stakeholder uses, including social and economic uses and ensure that poor communities in the vicinity of state-owned infrastructure benefit from that infrastructure.
- **Refurbishment and rehabilitation:** All water infrastructure is maintained to a high standard and at a capacity required to serve its purpose.
- **Job creation and economic development:** Infrastructure investment is used to create jobs and to facilitate equitable social and economic development.
- **Knowledge centre:** South Africa is recognised as an international knowledge centre in the fields of water re-use and desalination.

4.4 Strategic actions

4.4.1 Water Reconciliation Strategies

The DWA will continue, in partnership with stakeholders, to develop and maintain Reconciliation Strategies for balancing water supply and demand in critical and water-scarce catchments. The DWA will update the water balance scenario for the country as a whole.

4.4.2 Water for urban development

The Reconciliation Strategies and other water infrastructure planning will be aligned with government's vision for urban development and will, as a priority, ensure that there is sufficient water supply for the future development of South Africa's cities and towns.

4.4.3 Development and maintenance of a water investment framework

For details on the investment framework, see **Chapter 12**, Section 12.1.2.

4.4.4 Investment in infrastructure

Implementation of the following nine major DWA water resource infrastructure projects is in progress and some are near completion:

- De Hoop Dam on the Steelpoort River, an important tributary of the Olifants River, Mpumalanga, as Phase 2A of the Olifants River Water Resource Development Project (ORWRDP)
- Major pipelines for delivering water from de Hoop Dam
  (a) for domestic use on the Sekhukhune Plateau
  (b) to platinum mines in the Eastern Belt near Steelpoort
  (c) to augment supplies for mining and domestic use at Mokopane, and
  (d) for later augmentation of supplies for domestic and industrial use at Polokwane.
  These components are Phases 2B, 2C and 2D, to be followed by planned phases 2E to 2H, of the ORWRDP
- Major pipelines in Phase 1 of the Mokolo-Crocodile Water Augmentation Project to supply Lephalale, North West Province
- Raising of Hazelmere Dam in the Mdloti River, north of Durban, KwaZulu-Natal
- The Vaal River Eastern Sub-System Augmentation Project, comprising major pumping stations and pipelines from the Vaal River to Secunda to augment supplies to Eskom, Sasol and other strategic users on the Mpumalanga Highveld

- Spring Grove Dam on the Mooi River near Rosetta, KwaZulu-Natal Midlands, as part of the Mooi-Mgeni Transfer Scheme Phase 2 (MMTS-2) for augmenting the Mgeni River in supplying the eThekwini-Msunduzi metropolitan areas
- The Nooitgedacht Low Level Scheme, which supplies Orange River water to Nelson Mandela Bay (a municipal scheme)
- Raising of Clanwilliam Dam in the Western Cape Province to supply irrigators and small towns along the Olifants River (WC), as well as the town of Clanwilliam
- Raising Tzaneen Dam and construction of a dam at Nwamitwa on the Groot Letaba River in Limpopo Province to supply areas in the Mopani District Municipality and, specifically, the Greater Tzaneen and Greater Letaba municipalities. The project will benefit some 400 000 people by 2027 and will provide water for economic growth in the region, minimise the further lowering of the assurance of water supplies to the irrigation sector and provide for the establishment of resource-poor farmers on about 2 000 ha of land.

Phase 2 of the Lesotho Highlands Water Project (LHWP), comprising Polihali Dam as the main component, is being prepared for implementation by the governments of South Africa and Lesotho, through the Lesotho Highlands Development Authority (LHDA), with completion expected in 2020.

The following major water resource development and managementprojects are being considered by the DWA and investigations are at various stages of completion:

- Transfer of surplus effluent from Northern Gauteng to the Lephalale area
- Supply of water from the Vaal River to Eskom's Duvha Power Station at eMalahleni Local Municipality
- Water supply augmentation schemes for the Free State gold fields area and nearby southern North West Province area (Tlokwe/Potchefstroom)
- Water supply augmentation schemes for Mangaung metropolitan area
- Dam on the Mkomazi River to further augment supplies to the eThekwini-Msunduzi Metropolitan areas
- Dam on the Kouga River to supply Nelson Mandela Bay metropolitan area
- Increasing transfers from the Thukela River to supply the Mhlatuze urban area
- Development of a major storage dam in the Mzimvubu River catchment, with associated water supply infrastructure, to support socio-economic development in the Eastern Cape Province

A schedule of mega and large infrastructure investments now in the construction phase and those which are planned for the next 10 years is is provided in **Table 5 and Table 6**

4.4.5 Value engineering of infrastructure investment plans

For infrastructure funded by the DWA, the investment plans must be value-engineered to optimise the cost effectiveness of the proposals and to evaluate the appropriateness of the technology envisaged. Unnecessary complex and costly assets and processes, with their associated reliance on scarce specialist skills, which may not be available in many places, must be avoided.

Specific attention will be given to budgeting for the full life-cycle costs of projects and to reduce the life-cycle energy costs.

4.4.6 Improved operation of water resources systems

The DWA will cooperate with municipalities, water boards and CMAs to systematically develop and implement sound operating rules for all water supply systems in South Africa, including those shared with other countries. The systematic implementation of these operating rules by the responsible water institutions will be given high priority.

Appropriate monitoring of all aspects of the operation of water supply systems will be required. Data collected and recorded in this way is to be used for periodic audits and for supporting and reviewing the adequacy of the operating rules.

4.4.7 Asset management plans

The DWA will require all water institutions to prepare asset management plans, preferably GIS-based, starting with an assessment of the current status and capacity of their water infrastructure and focused on comprehensive asset management. Such plans must include realistic budget provisions for implementation of the plans.

The Water Trading Entity and TCTA will develop such asset management plans for national water resources infrastructure owned by the DWA.

4.4.8 Transfer of water resource infrastructure to the organ of state most capable of managing the infrastructure

As part of the process of compiling asset management plans, the DWA will re-assess which water resource infrastructure should reside with which organ of state and, where necessary, will arrange for the transfer of that infrastructure to the appropriate organ of state.

4.4.9 Rehabilitation of infrastructure

The DWA will increase the allocation of funds for the maintenance, rehabilitation and refurbishment of government-owned water infrastructure, through a business plan that is subject to approval by National Treasury.

The business plan will include provision for the rehabilitation of 25 dams that have been identified as requiring urgent attention for dam safety and operational reasons, as well as the refurbishment of state-owned canals and other infrastructure in order to reduce water losses.

The DWA will also require WSAs and water boards to prioritise investment in the refurbishment and upgrading of wastewater treatment plants to prevent the pollution of water resources.

4.4.10 Groundwater development and management

The DWA will implement the National Ground Water Strategy, thereby promoting the use of groundwater on a larger scale. The focus is on supplying water mainly for household use in remote rural areas, where levels of water services are often unacceptable, as well as in other situations where groundwater can contribute to the reliability of supply for domestic and other uses. These situations will be addressed through the implementation of recommendations from the Reconciliation Strategiesand from the All Town Studies, where attention will be given to compreh ensive water services planning and development and to agriculture-related development programmes.

The City of Cape Town is conducting feasibility studies of regional groundwater supply schemes in the Table Mountain Group Aquifer and the Cape Flats Aquifer, near Cape Town and Worcester (Breede Valley Local Municipality) respectively. A similar approach will be considered in other parts of the country where there may be potential for developing groundwater on a regional scale but where inadequate information is now available.

4.4.11 Water re-use

The DWA has developed a National Strategy for Water Reuse, which provides a considered approach to the implementation of water reuse projects. The National Strategy for Water Reuse is a sub-component of, and is consistent with the NWRS2 (see **Annexure D**).

The intention of the National Strategy for Water Re-use is to better inform decision-making surrounding this valuable resource through the development of guidelines for the implementation of water reuse projects. The guidelines will address the choice of wastewater treatment technology, water quality standards, project financing and tariff implications, implementation, and operations and maintenance. Particular attention must be given to public and stakeholder engagement, education and consultation.

The DWA will review water-related laws and regulations to assess the need for amendment to facilitate re-use and, in cooperation with the WRC, make water re-use technology development a key focus area for research. The DWA will also explore the use of new technologies for re-using wastewater and for using treated mine water, and will encourage the development of centres of excellence in this regard at selected universities.

Municipalities must conduct feasibility studies of water re-use options in all water-scarce areas. Such investigations are planned for eThekwini (treated effluent from eThekwini and KwaMashu), Nelson Mandela Bay, Rustenburg, Mangaung, Buffalo City, George-Mossel Bay, and Mbombela-Bushbuckridge over the next five years. Where the municipality lacks capacity to conduct such a study, the DWA will provide support.

The performance of existing wastewater treatment plants in terms of meeting discharge standards and reliability is critical to the successful integration of water re-use into Reconciliation Strategies and into water supply systems in South Africa. These facilities discharge treated wastewater into the water environment with consequences for the safety, economy and fitness for use of the water resources by downstream users.

The DWA will enforce discharge standards and address the management and performance failures of municipal-run wastewater treatment plans that are critical for the public acceptability of direct water re-use.

A structured water re-use communication strategy to convey factual and reliable information on all aspects of water re-use to the public will be developed and implemented by the DWA.

4.4.12 Desalination of seawater

The DWA has developed a National Desalination Strategy that contains a strategic approach to the planning, development and implementation of desalination to support more productive development and utilisation of national water resources. The National Desalination Strategy is a sub-component of, and is consistent with the NWRS2 (see **Annexure C**).

The DWA will work with the Department of Energy (DOE), the Department of Public Enterprises (DPE) and Eskom to ensure the integration of medium- and long-term planning for the development of energy and water resources. Particular attention will be given to the potential for the desalination of seawater for supplying coastal towns and cities where there are sufficient sources of electricity for this purpose.

The DWA will work with DEA and other responsible departments to develop an integrated, streamlined and time-effective approach to regulatory approval of works for the desalination of water.

The DWA will cooperate with the WRC, the Department of Science & Technology (DST), the Department of Trade & Industry (DTI) and the private sector to support the development of desalination technologies where South Africa has comparative advantages, especially in desalination processes related to mining and industry.

The DWA will promote the establishment of a centre of expertise and excellence in desalination technologies at one or more South African universities, or in an institution such as TCTA or the WRC, in support of this initiative.

4.4.13 Acid mine drainage

The DWA will engage with the DOE and DEA to ensure that appropriate conditions are placed on mining licences that will ensure that mines treat acid mine drainage to a suitable standard.

The DWA's Reconciliation Strategies will incorporate treated acid mine drainage as an additional resource, where appropriate. It will continue to undertake the planning necessary to develop feasible long-term solutions to acid mine drainage challenges throughout the country, similar to the work being done in the Witwatersrand area.

4.4.14 Rainwater harvesting

The DWA will continue to support the national rainwater harvesting programme, which, at present, focuses on the construction of above- and below-ground rainwater storage tanks for households in rural communities. The intention is to extend the programme to rainwater harvesting in households and office buildings in affluent neighbourhoods.

4.4.15 Hydro-electricity generation

The DOE, together with the DWA and National Treasury (NT), commissioned an investigation of the prospects for retrofitting hydroelectric generation equipment at exiting DWA dams with hydroelectric power potential. The DOE has shortlisted 14 sites for further detailed evaluation.

The services of Independent Power Producers (IPP) will be procured to construct and operate the hydroelectric power stations that are the most favourable and viable. The IPPs will be required to enter into agreements with the DOE and Eskom for the sale into the national electricity grid of the electricity to be produced.

The sites deemed worthy of further investigation are:

- Bloemhof Dam
- Vaal Dam
- Vygeboom Dam
- Goedertrouw Dam
- Ncora Dam
- Elandsdrift Dam
- Blyderivierpoort Dam
- De Hoop Dam
- Kwena Dam
- Albert Falls Dam
- Bergriver Dam
- Pongolapoort Dam
- Skoenmakers Chute
- Little Fish River Canal

The DOE Advisory Team is undertaking a due diligence evaluation of these possible projects to identify the associated risks and, together with the DOE, is considering the best means for procuring service agreements with IPPs.

The Kakamas Hydro Electric Power group, which was selected as the preferred bidder under Round 2 of the DOE's Independent Power Producer Procurement Programme, is well advanced with the Neusberg run-of-river hydroelectric power plant with an installed capacity of 12.57 MW near the town of Kakamas in the Northern Cape Province.

4.4.16 Multiple use systems

The DWA and CMAs will assist water institutions to promote and implement a multiple-use systems approach to develop water supplies for:

- at least basic domestic use
- social uses
- higher levels of domestic water services
- economic activities in support of community development

The basic water supply programme to rural and disadvantaged communities will be strengthened and supported by the DWA by ensuring that local communities can be supplied from existing reservoirs in relative proximity, but which are intended for other purposes. Arrangements such as those for water allocations, physical connections, operating rules and institutional matters must be put in place.

The DWA will implement the Social Assessment and Development Framework and motivate the allocation of funds available through the Regional Bulk Infrastructure Grant (RBIG) to assist communities that must be served by new water services infrastructure.

The water stored in the reservoirs of major dams can, where appropriate, be used for supporting local economic opportunities such as recreation and tourism. The DWA will support such multi-purpose uses provided that they can be motivated for inclusion in comprehensive Sustainable Utilisation Plans (SULP) for the reservoirs of state-owned dams. The use of water in dams for aquaculture, as a component of a SULP, will be supported by the DWA in consultation with the Department of Agriculture, Forestry and Fisheries (DAFF).

The DWA will also promote hydroelectric power development at state-owned dams, as discussed above.

4.4.17 Job creation

The DWA will promote the creation of temporary and sustainable job opportunities on the construction, operation and maintenance of all water infrastructure projects. Particular attention will be given to maximising the real benefits of employing labour-intensive methods of construction.

The potential for maximising the use of labour-intensive construction methods depends heavily on adopting an appropriate design approach. The opportunities for maximising the use of labour on the construction of water infrastructure designed with other objectives in mind, such as speed of construction, are negligible. The South African Institution of Civil Engineering (SAICE) and the WRC will assist the DWA in further investigating the potential for the use of labour-intensive construction methods to create temporary and sustainable job opportunities.

Table 5: Mega Projects (over R400 million per year for a minimum of three years, or at least R1 billion total project cost)

No	Project Name	Location	Current project stage	Project Descriptions	Outputs	Projects total Projects cost	Project completion date
Mega projects (over R400 million per year for a minimum of three years, or at least R1 billion total project cost)							
1	Mzimvubu Water Project	Eastern Cape	Feasibility study	Construction of the Ntabelanga Dam on the Itsitsa River, tributary of the Mzimvubu River, for multi-purpose development of, inter alia, irrigation, hydropower stations and possible inter-basin transfers for domestic and industrial use.	Dam, water treatment plant, pipelines, reservoirs	R20 billion	2019
2	Mkomazi Water Project: Smithfield Dam	KwaZulu-Natal	Feasibility study	To augment the water supply to eThekwini, uMgungundlovu and the surrounding areas.	Dam and water delivery tunnel	R10 billion	2022
3	Mvoti River - iSithundu Dam or Welverdiend Dam	KwaZulu-Natal	Feasibility study to start in 2014	To secure water supply to domestic and industrial users in the Lower Mvoti basin area (Stanger area, KZN).	Dam, pump station, diversion weir	R1 billion	2023
4	Lower Orange River - Vioolsdrift Dam	Northern Cape	Pre-feasibility study completed	To increase the yield of the Orange River to cater for increasing demand in the area	Dam	R561 billion	2020
5	Western Cape Water Supply System Augmentation Project: Voëlvlei Supplement Scheme	Western Cape	Feasibility study	To augment the water supply to the City of Cape Town and the surrounding areas.	Dam, abstraction works, pipelines, pump station	R500 billion	2020
6	Lusikisiki Regional Water Supply Scheme: Zalu Dam on the Xura River	Eastern Cape	Feasibility study	To secure water supply for domestic and small scale irrigation in Lusikisiki and surrounding areas.	Dam, water treatment plant, pipelines, reservoirs	R500 billion	2018

No	Project Name	Location	Current project stage	Project Descriptions	Outputs	Projects total Projects cost	Project completion date
7	Mzimkulu River-Ncwabeni Off-Channel Storage	KwaZulu-Natal	Feasibility study	Ensure a reliable water supply to the northern part of the Lower KZN South Coast during dry periods	Dam, pump station, pipeline	R540 billion	2018
8	Acid Mine Drainage (Phase 1) The implementation of emergency works in the Witwatersrand gold fields to protect the environment	Gauteng	Under construction	Refurbishment of an existing treatment plant in the Western Basin and construction of new pump stations and treatment plants in the Central and Eastern Basins to protect the environment.	Pump stations and treatment plant	R2.2 billion	2014
9	Acid Mine Drainage (Phase 2) The implementation of the long-Term solution in the Witwatersrand gold fields	Gauteng	Feasibility study	Long-Term Solution to address the Acid Mine Drainage associated with the East, Central and West Rand underground mining basins.	Treatment works, pipelines, and waste disposal facilities	R6.4 billion	2019
10	Lesotho Highlands Water Project Phase 2	International	Pre-design	To augment the Vaal River System which supplies water to Gauteng and surrounding areas.	Dam, tunnel and associated works	R9 billion	2020
11	ORWRDP (Phase 2A) - De Hoop Dam	Limpopo SIP 1: Unlocking the northern mineral belt with Waterberg as catalyst	Construction	Water supply to new mining developments, augmentation of domestic water supplies to urbanand rural users in the middle Olifants RiverCatchment area including Polokwane, Mokopane, Lebowakgomo and to various communities on the Nebo Plateau and Sekhukhune.	Dam	R3.1 billion	2012
12	ORWRDP (Phase 2B-H) - Bulk distribution (Sub-Phase2C) 2D not yet under construction	Limpopo SIP 1: Unlocking the northern mineral belt with Waterberg as catalyst	Construction	Phase 2B:Pipeline from Flag Boshielo to Mokopane, Phase 2C: De Hoop to Steelpoort link Phase 2D: 2nd pipeline Steelpoort to Mooihoek, Phases 2E to 2H: Under consideration	Pumping stations, pipelines, balancing dams, operational infrastructure and appurtenant structures	2C: R2,2 billion; 2D: R600 million	2014

No	Project Name	Location	Current project stage	Project Descriptions	Outputs	Projects total Projects cost	Project completion date
7	Mzimkulu River-Ncwabeni Off-Channel Storage	KwaZulu-Natal	Feasibility study	Ensure a reliable water supply to the northern part of the Lower KZN South Coast during dry periods	Dam, pump station, pipeline	R540 billion	2018
8	Acid Mine Drainage (Phase 1) The implementation of emergency works in the Witwatersrand gold fields to protect the environment	Gauteng	Under construction	Refurbishment of an existing treatment plant in the Western Basin and construction of new pump stations and treatment plants in the Central and Eastern Basins to protect the environment.	Pump stations and treatment plant	R2.2 billion	2014
9	Acid Mine Drainage (Phase 2) The implementation of the long-Term solution in the Witwatersrand gold fields	Gauteng	Feasibility study	Long-Term Solution to address the Acid Mine Drainage associated with the East, Central and West Rand underground mining basins.	Treatment works, pipelines, and waste disposal facilities	R6.4 billion	2019
10	Lesotho Highlands Water Project Phase 2	International	Pre-design	To augment the Vaal River System which supplies water to Gauteng and surrounding areas.	Dam, tunnel and associated works	R9 billion	2020
11	ORWRDP (Phase 2A) - De Hoop Dam	Limpopo SIP 1: Unlocking the northern mineral belt with Waterberg as catalyst	Construction	Water supply to new mining developments, augmentation of domestic water supplies to urbanand rural users in the middle Olifants RiverCatchment area including Polokwane, Mokopane, Lebowakgomo and to various communities on the Nebo Plateau and Sekhukhune.	Dam	R3.1 billion	2012
12	ORWRDP (Phase 2B-H) - Bulk distribution (Sub-Phase2C) 2D not yet under construction	Limpopo SIP 1: Unlocking the northern mineral belt with Waterberg as catalyst	Construction	Phase 2B:Pipeline from Flag Boshielo to Mokopane, Phase 2C: De Hoop to Steelpoort link Phase 2D: 2nd pipeline Steelpoort to Mooihoek, Phases 2E to 2H: Under consideration	Pumping stations, pipelines, balancing dams, operational infrastructure and appurtenant structures	2C: R2,2 billion; 2D: R600 million	2014

No	Project Name	Location	Current project stage	Project Descriptions	Outputs	Projects total Projects cost	Project completion date
13	Groot Letaba Water Develoment Project (GLeWAP) : Phase 2	Limpopo SIP 1: near Tzaneen	Feasibility study	Construction of Nwamitwa Dam in the Groot Letaba River to meet the projected growing primary requirements to the year 2025, to improve the water availability for the riverine ecosystem and to make provision for new resource-poor farmers.	Dam, water treatment plant, pipelines, reservoirs	R1.7 billion	2020
14	Dam Safety Rehabilitation Programme	Country wide	Construction	Rehabilitation of assets and dam safety work - continuous projects	Dam	R2.8 billion	
15	Raising of Clanwilliam Dam	Western Cape SIP 5: Saldanha-Northern Cape Development Corridor	Designs	Upgrading of the existing dam to improvestability and to augment agricultural water supplies to meet increasing demands.	Dam	R1.8 billion	2017
16	Mokolo/ Crocodile Water Augmentation Project (Phase 1)	Limpopo SIP 1: Unlocking the northern mineral belt with Waterberg as Catalyst	Construction	Augmentation of domestic and industrial water supplies to the new Eskom/IPP power station(s), extension of associated mining activities and fast growing population in the Lephalale area	Pumping station, pipelines, balancing dams, operational and national key point	R2.1 billion	2014
17	Mokolo/ Crocodile Water Augmentation Project (Phase 2)	Limpopo SIP 1: Unlocking the northern mineral belt with Waterberg as catalyst	Feasibility	Augmentation of domestic and industrial water supplies to the new Eskom/IPP power station(s), extension of associated mining activities and fast growing population in the Lephalale area. River management system.	Water conveyance infrastructure and appurtenant structures	R13.9 billion	2019

Table 6: Large projects (cost between R90 and R400 million per year-totalling at least R250 million but less than R1 billion)

No	Project Name	Location	Current project stage	Project Descriptions	Outputs	Projects total Projects cost	Project completion date
1	Sunday River Government Water Scheme: Lower Sundays	Eastern Cape	Feasibility Study	Extension of the Lower Sundays Government Water Scheme canal system with the emphasis to provide irrigation water to resource poor farmers	Canal, balancing dam, pipeline	To be determined	To be determined
2	Koonap River - Foxwood Dam and associated works	Eastern Cape	Feasibility Study	To secure water supply for domestic and small scale irrigation in Adelaide and surrounding areas.	Dam, water treatment plant, pipelines, reservoirs	To be determined	To be determined
3	GLeWAP Phase1: (Tzaneen Dam raising	Limpopo SIP 1: Unlocking the northern mineral belt with Waterberg as catalyst	Designs	To meet the projected growing primary supply requirements to the year 2025, to improve the water availability for the riverine ecosystem. Raising of Tzaneen Dam	Dam, water treatment plant, pipelines, reservoirs	R125 billion	2016
4	Raising of Hazelmere Dam	KwaZulu-Natal SIP 2: Durban-Free State Gauteng Logistics and Industrial Corridor	Designs	Augmentation of water supply to Umgeni Water for treatment to KZN North Coast (Mdloti to Thukela areas)	Dam (radial crest gates)	R360 billion	2017

CHAPTER 5
WATER RESOURCE PROTECTION

5.1 Context and current challenges

Water is a precious resource in South Africa and is fundamental to our quality of life. An adequate water supply of suitable quantity and quality makes a major contribution to economic and social development. To achieve this, healthy water ecosystems are imperative to sustain the water resource, which, in turn, provide the goods and services on which communities depend. This indivisibility of water is a cornerstone of the National Water Policy, to the extent that water ecosystems are not seen as users of water in competition with other users, but as the base from which the resource is derived, without which, growth and development cannot be sustainable.

The National Water Act, Chapter 3, prescribes the protection of the water resources through resource-directed measures and the classification of water resources. These are measures which, together, are intended to ensure the protection of the water resource as well as measures for pollution prevention, remedying the effects of pollution while balancing with the need to use water as a factor of production to enable socio-economic growth and development. Notwithstanding this legislative requirement, there has been a demonstrable drop in the aquatic ecosystem health across the country and increased stress on water resources, leaving little buffering capacity for any coming changes and increasing water demand. Our water resources are facing ever increasing pressures from climate change, population growth, over utilization of the water resource, poor land-use practices and subsequent pollution.

Well-functioning ecosystems, such as water quality improvement, streamflow regulation and flood attenuation, deliver a valuable service to people. Well managed water ecosystems can also buffer human settlements and built infrastructure against extreme events that are likely with climate change, playing a crucial and cost-effective role in disaster-risk reduction.

South Africa has made significant progress towards implementing sustainable water resource protection programmes, such as the development of the water resource classification system, the development and progressive implementation of Resource Directed Measures; development of a Pricing Strategy that will provide incentive based resource protection; implementation of wastewater risk abatement plans, such as the Green Drop certification for municipal wastewater treatment works to minimise pollution of the environment, as well as identifying key ecosystems as priority areas for conservation and the development of programmes to monitor and manage ecosystem health.

While the policies and programmes for water resource protection have been endorsed and adopted, the difficulty remains in how to implement them in a cost effective and sustainable manner within a reasonable time. Therefore, much still needs to be done in the areas of implementation of water resource protection programmes and monitoring of ecosystem health to proactively minimise degradation of the resource, focus rehabilitation efforts and ensure compliance to sustainability.

Strategic investment in our water ecosystem will result in long-term savings; for example, by reducing costs on developing additional infrastructure such as dams and reducing the pollution of resources, while improving the quality of resources.

Current challenges are discussed in this section:

5.1.1 Pressure from growth and development

In South Africa, water is not always available at the right times and in the right places to meet developmental demands and international obligations, while maintaining ecological sustainability. In recent years, because of the pressure to grow the economy as South Africa is a resource-driven economy, not much notice has been given to the natural ecological patterns that are required to ensure a healthy functioning ecosystem, resulting in the over-utilisation of water resources and habitat destruction. The flow regimes of our water resources are being altered through abstractions, inter-basin transfers, the construction of dams and weirs, as well as high return flows in urban areas which are not sustainable; water quality is deteriorating through poor effluent discharges, land-use practices and habitats are degraded or destroyed through sand-mining and other developmental activities. As a result, the country is losing critical biodiversity and sustainability of the water resource.

South Africa has implemented steps to mitigate the developmental pressures on the water resource, such as the development of National Freshwater Ecosystem Priority Areas; the protection of riparian and wetland buffers and critical groundwater recharge areas, as well as the rehabilitation of strategic water ecosystems.

5.1.1.1 National Freshwater Priority Areas

Development pressures mean it is not always possible to keep all water ecosystems in good ecological condition. However, to support the health and sustainability of water ecosystems and thus the provision of water-related ecosystem services, a certain proportion of water ecosystems need to be maintained in good ecological condition. It is best to identify these water ecosystems systematically and proactively, in the most efficient configuration, based on the best available science. South Africa has done this in the form of maps of National Freshwater Ecosystem Priority Areas (NFEPAs), which identify strategic spatial priorities for conserving water ecosystems and supporting the sustainable use of water resources.

NFEPA maps and their supporting documents are thus directly applicable to the National Water Act, feeding into Catchment Management Strategies and Resource Directed Measures. They provide a single, nationally consistent information source for incorporating water ecosystem goals into planning and decision-making processes.*

5.1.1.2 Protection of riparian and wetland buffers and critical groundwater recharge areas

Buffers of natural vegetation around water ecosystems play an important role in mitigating the negative impacts of adjacent land-use practices. Buffers and healthy riparian zones around rivers and wetlands are known to stabilise banks, trap sediments and filter out pollutants, thereby sustaining water quality and protecting aquatic habitats and associated biota. Rehabilitating and maintaining intact buffers and groundwater recharge areas is a high-priority intervention for improving water security in production landscapes, which are characterised by land uses such as agriculture and urban areas.

Often, setback lines are used to indicate how wide a buffer should be. However, limiting land use rights in buffer zones has direct financial consequences for land owners and developers. There is no agreement on a standard buffer in all situations, and it is thus important to determine appropriate buffers based on science. In the meantime, it is prudent to implement a statutory minimum setback line to mitigate impacts on, and ensure the persistence of critical water-related ecological infrastructure. Other legislation (NEMA and CARA especially) refers to explicit setback lines around water resources, and significant work has gone into developing a technical tool for buffer delineation in the water sector.

Limiting the effectiveness of buffers or contributing to reduced water quality imposes significant costs on downstream users and society. The costs of damage to and rehabilitation of water resources need to be more accurately quantified and allocated equitably between polluters and water users. Prevention is often far cheaper than mitigating these impacts. This can be readily pursued by clarifying the compliance monitoring and enforcement responsibilities of all natural resource management authorities, the delineation of buffer zones for restricting certain activities, and controlling the use of agro-chemicals, particularly in and adjacent to water ecosystems.*

5.1.1.3 Rehabilitation of strategic water ecosystems

Government policy and strategies for responding to the extent of loss and degradation of water ecosystems have recognised that there is a need for a combination of proactive measures for maintaining healthy wetlands, together with remedial interventions focused on past degradation.

Research has shown that degradation of these ecosystems is not necessarily permanent and that it is possible to reinstate at least some ecosystem services through rehabilitation. A number of government programmes, including the Natural Resource Management programmes of DEA and Land Care in DAFF, focus on the rehabilitation of water ecosystems to varying degrees. As part of the Expanded Public Works Programme, these programmes generate additional value by maximising employment creation, supporting small emerging businesses and transferring skills to beneficiaries drawn primarily from those groups most excluded from the mainstream economy.

Significant public funds are invested in the rehabilitation of water ecosystems annually, and the science and practice of rehabilitation is accordingly well developed in South Africa. Research undertaken in South Africa shows that many rehabilitated wetlands are successfully and sustainably delivering a higher level of services than before rehabilitation, thereby allowing them to better perform their role as ecological infrastructure. There remains immense potential, however, for scaling up of rehabilitation programmes, and for better integrating their outputs in support of priority actions and areas for water resource management, such as those articulated through the NWRS2.*

5.1.2 Protection of international rivers

The high number of trans-boundary rivers means populations in the SADC rely on water that is generated outside their borders to supply more than half of their total water resource stock (FAO, 2006). Most of South Africa's rivers are shared watercourses with other SADC countries. Although South Africa is a signatory to the Revised Protocol on Shared Watercourses in the Southern African Development Community the implementation of the protocol, in particular, on the protection of the resource is complicated because of the governance issues of shared watercourses. This complicates water management in the region as well as linking the developmental futures of neighbouring states.

Developments on an upstream section of a river, such as a dam for water supply, irrigation or hydropower impact the flow downstream. These impacts range from a drop in the quantity of water available downstream to various water quality-related issues. If water is used for intensive agricultural production, the return-flow typically has high levels of nutrients associated with fertilizer use as well as pesticides and higher salinity content. This will impact on the ability of downstream ecosystems to operate effectively with nutrient build-up leading to eutrophication of the rivers and a general drop in water quality.

A drop in the overall quantity of water flowing downstream due to consumptive use upstream will exacerbate the situation, potentially reaching the tipping point, beyond which, the ecosystem can no longer absorb and process the nutrients and other pollutants being passed on to it.

5.1.3 Climate change

Climate change will alter the environment and present new challenges in the future. The manifestations of climate change include higher temperatures, altered rainfall patterns, and more frequent or intense extreme events such as changes in flow patterns, drought and storms (Marsden Jacob & Associates, 2006). This, in turn, will affect where and what types of plants and animals can survive the quality of their habitats and their abundance.

The rate and scale of change will affect different species in different ways as they try to adapt to changing habitats. Some of the sites of nature conservation interest that are being protected today may be increasingly vulnerable to irreversible changes of habitat and species. We can assist in this adaptation by ensuring healthy ecosystems that can easily adapt to changing conditions, by reducing the stresses imposed on the water resource through abstraction and discharges, restoring and improving habitats where damage is caused by use.

By protecting water resources, a system that is more resilient to the impact of climate change, such as floods and droughts will be ensured. In addition, a healthy functioning ecosystem can assist in mitigating some of the impacts of climate change on society. For example, well-functioning wetlands can minimise the impacts of floods and ensuring good riparian habitat can provide shading and minimise evaporation from the water resources. Groundwater aquifers can provide safe storage of water for use, if they are protected and not over-abstracted or polluted, for example, by untreated effluent and acid mine drainage.

5.1.4 Water quality issues

The findings from the planning level review of water quality in South Africa, conducted in 2010 (DWA, 2010) focussing on the chemical quality issues facing the country are summarised in **Table 7**.

Pollution from wastewater treatment works has become a major concern in South Africa as most wastewater treatment works are overloaded. A strategic approach to minimising the contamination of the resource to which treated effluent is returned, the reduction or removal of contaminants through treatment processes and the prevention of contamination during the conveyance of wastewater; storage and disposal of sludge, has been developed and implemented in a few municipalities, such as Nelson Mandela Bay and City of Cape Town. The Green Drop certification, part of the Wastewater Risk Abatement Plan, has been implemented across all municipalities and private wastewater treatment works and reflects the state of compliance and assistance that needs to be provided to municipalities to decrease their wastewater risk to the environment.

5.1.5 Microbiological quality

Regional consultation with stakeholders has indicated that the microbiological quality of the water resources is also deteriorating. Sufficient data is still required to understand the extent of the problem. Major problem areas and pollution sources include untreated or poorly treated discharges from wastewater treatment works and run-off as well as leaching from unserviced areas.

Communities are at high risk of being affected by waterborne diseases when drinking water directly from the river without any treatment and using the water for recreation, washing and irrigation purposes.

Table 7: Summary of water quality issues identified and the WMAs in which they are a cause for concern

Water Quality Issue	Driver	Effect	WMA's associated with water quality issue
Eutrophication	Wastewater treatment works; Intensive agriculture; fertilizer use; Dense urban sprawlun-serviced sewage	Algal growth, smell, toxic algae, water treatment extra costs, taste and odour; irrigation clogging, aesthetics, recreational water users,	Limpopo (1), Luvuvhu and Letaba (2); Crocodile Westand Marico (3); Olifants (4); Inkomati (5); Usutu toMhlatuze (6); Thukela (7); Upper Vaal (8); Middle Vaa l(9); Lower Vaal (10); Mvoti to Umzimkulu (11); Mzimvubu to Keiskamma (12); Upper Orange (13); Lower Orange (14); Fish to Tsitsikamma (15); Olifants-Doorn (17); Breede (18); Berg (19)
Microbial contamination	Wastewater treatment works; Informal dense settlements; Vandalism of sewage reticulationsystem andpumping infrastructure Sewage spills into receiving streams	Recreational users (human health risks), washing and bathing; Poor bacterial water quality; Impacts on downstream users Low dissolved oxygen andecosystem impacts; Water-borne diseases	Limpopo (1), Luvuvhu and Letaba (2); Crocodile Westand Marico (3); Olifants (4); Inkomati (5); Usutu toMhlatuze (6); Thukela (7); Upper Vaal (8); Middle Vaa l(9); Lower Vaal (10); Mvoti to Umzimkulu (11); Mzimvubu to Keiskamma (12); Upper Orange (13); Lower Orange (14); Fish to Tsitsikamma (15); Olifants-Doorn (17); Breede (18); Berg (19)
Salinisation	Mines (operational and abandoned); Wastewater treatment works; Agricultural runoff	Mines (operational and abandoned); Wastewater treatment works; Agricultural runoffWater treatment costs, soil salinity, irrigation system clogging	Limpopo (1), Luvuvhu and Letaba (2); Crocodile Westand Marico (3); Olifants (4); Inkomati (5); Usutu toMhlatuze (6); Thukela (7); Upper Vaal (8); Middle Vaa l(9); Lower Vaal (10); Mvoti to Umzimkulu (11); Mzimvubu to Keiskamma (12); Upper Orange (13); Lower Orange (14); Fish to Tsitsikamma (15); Olifants-Doorn (17); Breede (18); Berg (19)
Toxicants	Pesticides (subtropical fruits, nuts) industry, DDT for malaria control	Fish kills, human health, bioaccumulation, KNP mammals	Luvuvhu and Letaba (2), Crocodile Westand Marico (3); Olifants (4); Inkomati (5); Upper Vaal (8)
Altered flow regime	Dams and weirs Inter-basin transfers	Turbidity (erosion), Algal growth, water temperature increase, dissolved oxygen changes, taste and odour changes, changes in environmental flows; Seasonal flow changes, ecological water requirement changes, impact of recreational water users	Luvuvhu and Letaba (2), Olifants (4); Inkomati (5); Middle Vaal (9); Lower Vaal (10); Upper Orange (13); Lower Orange (14)
Acid mine drainage	Mines (operational and abandoned), Controlled releases	Mobilisation of metals, Fish and crocodile kills, bioaccumulation, low pH, elevated sulphur and iron, elevated salts and dissolved metals	Olifants (4); Inkomati (5); Usutu to Mhlatuze (6); Upper Vaal (8)

Water Quality Issue	Driver	Effect	WMA's associated with water quality issue
Metal contamination	Mines (operational and abandoned) Uncertain in some instances	Mobilisation of metals, Fish and crocodile kills, bioaccumulation, KNP mammals; Potentially harmful for human health and for the aquatic environment.	Olifants (4); Inkomati(5); Lower Orange (14)
Suspended solids (turbidity, sedimentation)	Land degradation and overgrazing; soil erosion; mining; Informal dense settlements, subsistence agriculture	High suspended solids during high flows; silting up of rivers, weirs and dams; loss of habitat, increased water treatment costs, irrigation clogging	Limpopo (1), Luvuvhu and Letaba (2); Crocodile Westand Marico (3); Olifants (4); Inkomati (5); Usutu to Mhlatuze (6), Thukela (7); Upper Vaal (8); Mvoti to Umzimkulu (11); Mzimvubu to Keiskamma (12); Upper Orange (13)
Radioactivity	Discarded mine dumps	Bioaccumulation fish, aquatic organisms, soils, humans. Carcinogenic effects.	Upper Vaal (8); Middle Vaal (9)
Urban rivers	Urban rivers Poor quality storm water runoff and dry weather flow from dense settlements	Poor bacterial water quality Human health risks; Impacts on ecosystems (low DO)	Upper Vaal (8); Fish to Tsitsikamma (15); Gouritz (16); Berg (19)
Agro-chemicals	Pesticide and herbicide residues Endocrine disrupting chemicals	Interfere with hormone system of organisms; Ecosystem impacts	Fish to Tsitsikamma (15); Olifants-Doorn(17); Breede (18); Berg (19)

Source: DWA, 2010. Directorate Water Resource Planning Systems: Water Quality Planning. Resource Directed Management of Water Quality Planning Level Review of Water Quality in South Africa. Sub-series No.WQP 2.0. Pretoria, South Africa.

5.1.6 Protection of strategic water source areas

Strategic Water Source Areas supply a disproportionately high amount of the country's mean annual runoff in relation to their surface area. These areas make up 8% of the land area across South Africa, Lesotho and Swaziland, but provide 50% of the water in these countries.

The 2011 National Biodiversity Assessment revealed that 48% of the country's wetland types are critically endangered, followed by 39% of estuary types and 25% of river types (in comparison to 9% of terrestrial ecosystem types).

These high levels of threat to our wetlands are consistent with global trends. Although no systematic national survey of wetland loss has been undertaken, studies in several major catchments have revealed that 35-60% of the wetlands, and the benefits they provide, have been lost or severely degraded. It is likely that the extent of wetland loss and degradation for the country lies within this range. Strategic Water Source Areas have been identified for the whole of South Africa, including Mountain Catchment Areas, and some coastal areas, such as Pondoland **(Figure 8)**.

These areas form the foundational ecological infrastructure on which a great deal of built infrastructure for water services depends. They are thus strategic national assets that are vital for water security, and need to be acknowledged as such at the highest level across all sectors.

Appropriate management of Strategic Water Source Areas, can produce significant returns in terms of water quality and quantity. Investing in Strategic Water Source Areas is also an important mechanism for long-term adaptation to the effects on climate change on water provision growth and development.

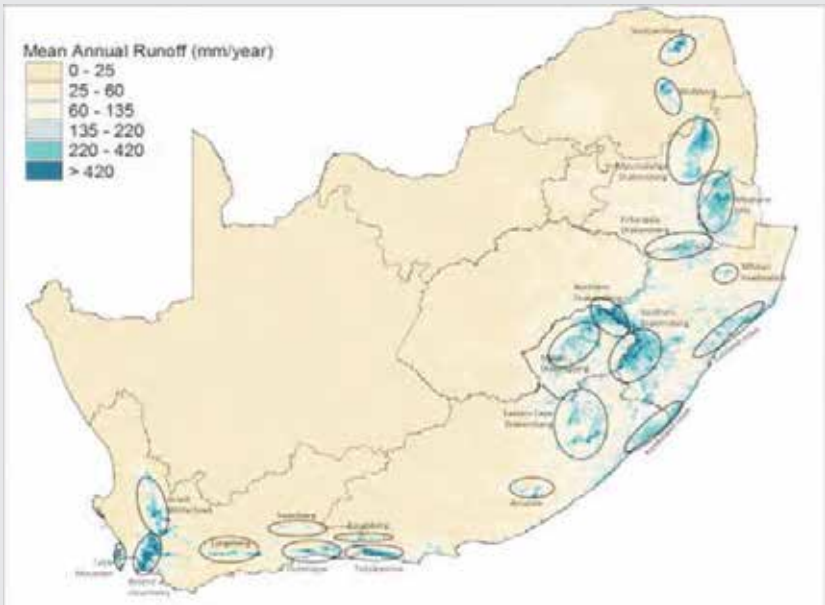


Figure 8: Strategic water source areas for South Africa

The areas >135 mm/year represent strategic water source areas in South Africa, Lesotho and Swaziland. These areas occupy approximately 8% of the land surface and contribute 50% of the water supply.*

5.1.7 Lack of awareness of the value of water resources

Many South Africans are not aware of the scarcity of water in the country and that if the water is not managed well, there will not be enough to meet all the demands. People need to value water much more and use it more efficiently. This means that they need to recognise water as a valuable resource and invest in technologies and communications that will improve the way that it is used and managed.

Although some work has been done in linking the environmental benefits of water and its economic benefit, more must be done to understand the linkages. There is a need to improve on the current technologies.

- developing a common framework for the economic analysis of ecological benefits, and
- discussing the elements of ecological risk assessment and economic benefit analysis.

The challenge is to work with businesses, organisations, communities and individuals to ensure that they value water and the water environment. The aim is to change habits by providing better information so that they can make more informed choices and use water more efficiently

Addressing these challenges is a considerable feat that cannot be undertaken by the DWA alone; it requires cooperative governance with the Departments of Environmental Affairs, Agriculture, Forestry and Fisheries, Mineral Resources, Energy, Economic Development, Human Settlements, and Rural Development and Land Reform as well as the business sector and communities.

5.1.8 Lack of monitoring to inform management actions

To inform the management of water ecosystems, information about the ecological state of these systems as well as the trajectories and rates of change taking place in that state is needed. Such information is obtained through monitoring selected indicators, which can be defined as "measures, variables, or indices that represent or mimic either the structure or function of ecological processes and systems across a disturbance gradient" (Brooks et al. 1998).

The information from such monitoring is necessary for evaluating the effectiveness of past management decisions, demonstrating the outcome of service delivery and refining management approaches and policy options. Sound scientific monitoring and effective and transparent communication of monitoring results can also be a powerful catalyst for participatory water resource management

Experts from several fields of study (such as fish biology, entomology, botany, geomorphology and chemistry) are required to monitor aquatic ecosystems in a holistic way. Few, if any, organisations employ people covering this full suite of expertise. Therefore, to sustainably monitor the health of water ecosystems, cooperation and commitment across national, provincial and local organisations/agencies with water management mandates will be necessary. The design and maintenance of a monitoring and reporting programme can facilitate and encourage collaboration between the wide range of stakeholders involved in water ecosystem management.*

5.2 Principles

The key principles to enable water resource protection are founded on ensuring that sufficient water is left in the rivers to sustain ecosystem functioning, that the quality of the resource is protected at the source and that the water environment has an intrinsic value for economic and social growth.

Principle 1:
Protection of the resource through classification of the resource with the Reserve[1] as a prior right. The most critical resource protection imperative over the next five years is the use of the gazetted classification process to classify all the major rivers, wetlands and aquifers. This should involve stakeholder engagement to create ownership of the water resources. The amount of water available to allocate will be determined after accounting for the Reserve , the international obligations and the water requirements for power generation, which is considered a strategic sector.

Principle 2:
Water resource protection should be based on a participatory approach, involving users, planners and policymakers at all levels. The participatory approach to water resource protection should involve raising awareness of the importance and value of water among policymakers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the management of our water resources.

Principle 3:
The value of water resources must be recognised from an economic point of view and the social and environmental benefits of the resource. It is important that society recognises determining the economic value of water, accounting for the use of water (for example, household water supply and irrigation for agriculture) and the ecosystem services provided or supported by water resources (for example, nutrient cycling, habitat provision, and recreation).

Principle 4:
Water resource protection must guide setting conditions for water-use authorisation. Water resource protection is effected through Resource Directed Measures (RDM), which set the goals for optimising the allocative efficiency of the water resource among its competing demands, and Source Directed Controls (SDC), which set abstraction and discharge licence conditions, financial and economic measures, and other regulatory processes for controlling water use. The potential impacts on the quality of the resource (this includes the quality of all aspects of the water resource, including water quality, the integrity of riparian and instream habitats and aquatic organisms), will be considered when granting a licence in order to ensure that water resources are protected.

Principle 5: Incentive based protection of the water resources. To manage the quality of the water resource and protect the ecosystems, the waste discharge charge system must be used as an instrument to improve the quality of the degraded rivers wetlands and aquifers.

Principle 6: Integrated Protection of aquatic ecosystems. The complex and interconnected nature of catchments as social-ecological systems must be recognised and the aquatic ecosystem (water quantity and quality, habitat and biota) are to be managed in an integrated way.

5.3 Objectives

The key strategic objectives for water resource protection are to:

- Ensure sustainable management of the water resources through resource directed measures and source directed controls.
- Protect and maintain existing freshwater ecosystem priority areas in good condition and well-functioning water resource ecosystems by managing riparian and wetland buffers and critical groundwater recharge areas.
- Carry out rehabilitation of strategic water ecosystems.
- Ensure prevention of water resources from point source and non-point source pollution by managing at source.
- Create awareness among communities, business and decision makers about the value of water and ensure commitment to sustainable water use practices.
- Create an enabling environment for water resource protection through incentive based approach to water resource management.
- Monitor the ecological health of our resources through an integrated information management system.

5.4 Strategic actions

5.4.1 Manage for sustainability using resource directed measures

A management class, and associated Reserve and resource quality objectives (RQO) have been set and approved for every significant water resource in the country. Resource quality objectives are regularly monitored for compliance, which informs enforcement and a strategic adaptive management cycle.

Water ecosystems are maintained in the desired state. revenues are reinvested in the management of these areas for their water resources.

[1]The Reserve includes the water quantity and quality needed to maintain aquatic ecosystems in a particular state, as well as the water required to meet basic human needs.

5.4.2 Invest in strategic water source areas

National Strategic Water Source Areas are endorsed and acknowledged as strategic national assets at the highest level in all sectors. They all enjoy legal protection that allows land to be managed in a way that does not significantly undermine their role as key water sources. The costs of catchment management of these areas are factored into the water price, and revenues are reinvested in the management of these areas for their water resources.

5.4.3 Strategic investment in the maintenance and rehabilitation of water ecosystem

Sufficient financial investment, through the Water Pricing Strategy and the waste discharge charge system must be allocated towards the maintenance and rehabilitation of key identified water ecosystems.

5.4.4 Maintain Freshwater Ecosystem Priority areas in good condition

All National Freshwater Ecosystem Priority Areas, which identify priorities for conserving water ecosystems and supporting the sustainable use of water resources, are considered in the determination of Resource Directed Measures.

5.4.5 Protect riparian and wetland buffers and critical groundwater recharge areas

Buffers and critical groundwater recharge areas are recognised as critical ecological infrastructure supporting water security and are kept intact, maintained and restored to support water quantity and quality.

5.4.6 Rehabilitate strategic water ecosystems to support water quantity and water quality

The priority rehabilitation needs of water ecosystems are identified, and an appropriate level of investment in the rehabilitation of degraded ecosystems is in place to improve the sustainability and performance of key water-related ecological infrastructure.

5.4.7 Monitor ecological health to inform management

Sound monitoring (indicators, sites and frequency) is conducted by experienced inter-departmental /agency teams at the scale of WMAs.

The resulting information on the state of, and trends in, ecosystem health is packaged and communicated to inform relevant water resource management, decision making and policy processes (see **Chapter 13**). Dynamic feedbacks between monitoring and research ensure that emerging concerns are investigated and that the monitoring programme(s) remains relevant.

**Extracted from an unpublished report by C Colvin, prepared on behalf of SANBI, WWF and CSIR as input to NWRS2.*

Existing monitoring programmes, in varying phases of maturity, serve as a basis for refining, expanding and strengthening the monitoring of the health of water ecosystems. These programmes include the national River Health Programme, Wetland Health Programme and Estuary Health Programme.

There is an urgent need to initiate an Aquifer Health Programme to monitor the health and extent of pollution of significant aquifers.

Where necessary, programmes are revitalised, expanded and revised so that the location of monitoring sites considers NFEPAs.

5.4.8 Minimisation of pollution from wastewater treatment works

Ensuring that efficient water use is sustainably implemented to reduce the amount of municipal sewage produced (see **Chapter 7**) should include the development and implementation of wastewater recycling systems to minimise the discharge of sewage into the water resources.

Sustainable implementation of Wastewater Risk Abatement Plans, such as the Green Drop certification across all municipal and private wastewater treatment works, should be assessed.

5.4.9 Establishing commitment to sustainable water resource management

Water valuation must be integrated into water resource decision making by ensuring water resource protection gains acceptance among all stakeholders involved.

Current and appropriate valuation methods and processes need to be further developed and refined where the decision context can play a role in addressing water resource protection and enabling communities, business and decision makers to have ownership in the decisions made on water resource protection. This includes stakeholder engagement in creating an enabling environment for appraising decisions where trade-offs between use(s) of water and/or services supported by it are evident.

The pricing of water (see **Chapter 12**) needs to better reflect its value.

5.4.10 Target actions with immediate benefits

The sector, led by DWA, will identify priority actions that will result in immediate benefits for the country, including additional water available for irrigation use by emerging farmers, which has been estimated to be between 100 000 and 200 000 hectares.

CHAPTER 6
EQUITABLE WATER ALLOCATION

6.1 Context and current challenges

The National Water Act (NWA) stipulates equity, sustainability and efficiency as the key guiding principles for water resources management in South Africa. However, since the promulgation and implementation of the NWA, one principle that has not received the desired attention is equity, resulting in the perpetuation of inequitable water allocation.

Equitable access to water, or to the benefits derived from using water, is critical to transformation in the water sector, contributing to eradicating poverty, and promoting equitable sustainable economic growth. Little substantive progress on the NWA pillar of equity has been achieved since its promulgation, that is, the redress of race and gender water allocations for productive economic uses.

The NWRS2 is centred on the recognition of water as a basic human need and recognition of its critical role to ensure equitable and sustainable socio-economic development. The principle of equity means that special attention must be given to the needs of those that were historically denied access to water or to the economic benefits of water. Equity implies a concept of fairness, which allows for different practices in the management of water in response to different social, economic and environmental needs.

To bring equity to a practical level, it is important to distinguish between equity in access to water services, equity in access to water resources and equity in access to the benefits from water resource use through economic, social and environmental development and management.

6.1.1 Equity in access to water services

The Water Services Act (Act 108 of 1997) translated the Constitutional right of "access to sufficient water"[2] into firm definitions in terms of quantity, quality and assurance of supply. Since 1994, impressive progress has been made in providing millions of South Africans with access to a safe water supply as the backlog has been significantly reduced over the period from 1994 to date.

While major investment in water resources infrastructure has enabled the provision of reliable water supplies to large urban areas, in large parts of the rural areas, to commercial water users and to the various economic sectors, there are still many South Africans who suffer from water insecurity and lack access to reliable water supplies for domestic and productive purposes. The NWRS2 recognises the need to address equitable allocation as envisaged in the legislation, which has not yet been fully realised.

6.1.2 Equity in access to water resources

Equity in access to water resources deals with the concept of direct access to water for productive purposes, such as water for irrigating crops or water for a business or an industry. Therefore, critical to the NWRS2 is the requirement to address equity in water allocation and to ensure the beneficial use of water to create jobs, contribute to poverty eradication and reduce the major inequality of South African society.

6.1.3 Equity in access to the benefits from water resource use

Equity in access to the benefits from water resource use means that water must be allocated so that it brings maximum benefit to all, whether directly or indirectly. Achieving this will require emphasising associated opportunities such as renewing infrastructure, investing in human capabilities, stimulating innovation and technological development, redressing historical inequalities and increasing participation in the governance and management of water. It also requires an appreciation of new potential challenges such as climate change and how this might influence current and future strategies.

6.1.4 The WAR programme

The DWA established the water allocation reform (WAR) programme dedicated to redressing inequity (race and gender) and poverty eradication. The WAR programme entails:

Water set-aside:
Water may be set aside in a catchment, specifically for allocation to black and women users. In stressed catchments, water that becomes available (for example, from water conservation, water demand management and illegal water use recovered during the verification and validation process) will be set aside for black and women users.

General Authorisations:
General Authorisations (GA), in terms of the NWA, may be gazetted for specific catchments for the allocation of water resources to black and women users. This will facilitate the uptake of water by these designated groups to ensure the achievement of the set race and gender targets.

[2] Department of Water Affairs and Forestry. Water Services Act (Act 108 of 1997). Pretoria, 1997

Partnerships:
Meaningful partnership initiatives, when encouraged and implemented on a scorecard basis, may be used to facilitate WAR. Partnership initiatives will be encouraged through various forms of incentives such as Joint Venture initiatives and Public Private Partnerships.

Development support:
Targeted beneficiaries of WAR do not often have the financial means to participate meaningfully in water-based economic activities. To facilitate the achievement of sustainable reform targets through viable sector economic activities, financial support in the form of subsidies, grants, funding of infrastructure, voluntary donations and technical inputs (including all forms of extension services) will be made available to the beneficiaries of WAR.

Water based business enterprises:
Business initiatives and local and regional economic development programmes will be used to attract targeted beneficiaries of WAR to consider, develop and enter into water-based business enterprises. Specifically, state water infrastructure will be used for economic activities such as tourism and recreation.

Compulsory licensing:
Compulsory licensing, as one of the mechanisms of WAR, is the process where all the water uses in an area are reviewed and water is re-allocated according to specific imperatives, needs and requirements. The reasons for introducing compulsory licensing may be any or all of the following:

- Achieve a fair allocation of water from a water resource (surface- or groundwater) which is under water stress, or to review prevailing water use to achieve equity in allocations
- Promote beneficial use of water in the public interest
- Facilitate efficient management of the water resource
- Protect water resource quality

Compulsory licensing will be prioritised in areas that are water stressed (over-allocated) and this priority will be based on the need to achieve equity through water re-allocation and to protect water resources from being over-exploited.

Some key lessons emerging from current compulsory licensing projects include:

- On-going stakeholder engagements are essential during the planning and implementation phases
- Project delays must be avoided since these result in adverse unintended consequences such as stakeholder fatigue and a loss of faith in the process
- Openness and transparency by the DWA mitigates racial discord and mistrust
- Ensure cooperation from existing users since a lack of cooperation will hamper the process
- Recognise that the process is resource intensive and requires experts and specialists in a number of water management disciplines

The limitation with compulsory licensing is that it is a legally and technically complex process and should not be the only means relied upon for achieving WAR.

6.1.5 Current status
Allocations are still largely in the hands of the previously advantaged. Most of the current water use licence applications are still from this group, usually with no indication of how the allocations will contribute to redress and equity.

The implementation of the WAR programme has not yet covered the entire scope outlined above. For example, compulsory licensing has not been widely implemented. To date, it has been completed in the Tosca Molopo groundwater area (North West Province) and the Jan Dissels catchment (Western Cape Province). It is still underway in the Mhlathuze Catchment (KwaZulu-Natal Province), and planned for all water stressed areas.

To address the challenges of the WAR programme, the DWA developed the WAR Strategy to fast-track equity, redress (race and gender) and poverty eradication. The strategy is informed and is supported by sector (economic) equity needs relative to their benefits, as well as other considerations. The WAR programme approach is to take proactive and purposeful action towards addressing matters of social equity on a structured basis at all levels of government.

6.1.6 The key challenges
Although South Africa's water policy and legislation has been hailed as advanced in respect of addressing equity issues, over the past 14 years there have been significant challenges that have hampered the progressive realisation of its equity goals.

The main issues relate to:
- Weak internal coordination and integration
- Poor external alignment with other reform programmes
- Legislative impediments
- Lack of support for HDIs to access water and the productive use of their allocations

6.1.7 Conflating means and ends
It is critical that the strategies presented in the NWRS2 support the ends set out in the National Water Policy[3]:

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

[3] Department of Water Affairs and Forestry. White Paper on a National Water Policy for South Africa. Pretoria, 1997

This statement is based on principles of equity, sustainability and efficiency. The NWRS2, therefore, is aimed at managing water resources in a manner that will achieve optimum, long-term, environmentally sustainable and equitable social and economic benefits for society. These aims and values must remain central and conscious in the interpretation and implementation of the NWRS2.

Since water management is complex and operates within a complex social, economic and ecological environment, it is not certain that specific activities will lead to particular outcomes. It is thus critical that the NWRS2 sets clear outcomes, and that progress towards these outcomes is monitored and assessed regularly. Also, it is important that adaptive management approaches are used to ensure that changes can be made where sufficient progress towards the outcomes is not being achieved.

Equally important is the participation of people in water management. In particular, the participation of the poor is critical in eliminating poverty and ensuring the political legitimacy of policies and strategies. Participation has evolved over the last 18 years from a passive model to a more action-oriented concept. Top-down consultation has been replaced by citizen participation, which is a critical approach underpinning and supported in the NWRS2 in addressing the issues of inequity and poverty.

Beyond consultation is the true empowerment of HDI water users to actively participate in the processes underlying water resources management and using water resources to realise the outcomes of sustainable livelihoods and sustained socio-economic prosperity.

6.1.8 Water allocation priorities

The objective for management of water resources is to achieve optimum, long-term, environmentally sustainable social and economic benefit for society from their use.

This recognises that water has social, economic and ecological value. It is also recognised that weighing up the social and/or economic benefits of competing water uses is not easy and becomes more complex when the ecological costs and benefits must be considered as well. This means that the decision on how best to allocate water between competing uses requires a complex and difficult assessment, which includes the ability to assess social, economic and ecological values arising from various water uses. However, there is an overall insufficient appreciation of the value of water, the challenges of the water situation and the effort required to make water available on a sustainable basis, as reflected in the way water is wasted, water resources are polluted and aquatic habitats are degraded. These same factors reveal weaknesses in the current governance arrangements and the priority accorded to water in the social agenda.

An understanding of the social, economic and ecological value of water influences its allocation. Based on the limited availability of fresh water for further development and the need to choose between competing uses for water, it is necessary to put in place clear priorities for allocating water, whether by DWA or CMAs.

Priority 1
In line with the Constitution and the National Water Act, the highest allocation priority is afforded to water for the purposes of the Reserve. The first objective is to ensure that sufficient quantities of raw water are available to provide for the basic water needs of people. In terms of current policy, a quantity of 25 litres per person per day has been incorporated in the Reserve determination. Even though this is the minimum volume, this will be progressively increased where appropriate.

The second objective is ensuring sufficient water of an appropriate quality to sustain healthy aquatic ecosystems. Comprehensive work is continuing in this regard.

Priority 2
South Africa is committed to managing shared river basins in line with the revised Protocol on Shared Watercourses in the SADC and in terms of specific agreements with riparian states. The second-highest priority, therefore, is meeting international water requirements in terms of the agreements with riparian countries.

Priority 3
The third highest priority is accorded to the allocation of water for poverty eradication, the improvement of livelihoods of the poor and the marginalized, and uses that will contribute to greater racial and gender equity.

Priority 4
The fourth highest priority is accorded to the allocation of water for uses that are strategically important to the national economy, as described in Section 6(1)(b)(iv) of the National Water Act. These are uses that are of critical importance to the nation and must be authorised by the Minister. The uses include:

- The transfer of water from one water management area to another.
- The continued availability of water to be used for electricity generation throughout the country.

Priority 5
The fifth priority will be water used for general economic purposes, which includes commercial irrigation and forestry. In this category, allocation is best dictated by prevailing local and regional dynamics and requirements. Demand will reflect the value of water in particular economic sectors and will encourage uses that create employment, contribute to the economy (GGP) and are efficient.

All five priorities must give effect to allocations that promote equity.

6.1.9 Water use authorisations

The hierarchy of priorities forms the basis for the evaluation of water use authorisation applications when making water allocations. Section 27 of the NWA is the enabling legislative mechanism for this process, whether through individual authorisations or compulsory licensing.

Additional factors considered in assessing priorities for the allocation of water are the level of assurance of supply required, the consumptiveness of use and the quality of return flows.

Furthermore, Section 29 of the NWA allows the inclusion of specific conditions to licences or general authorisations as may be warranted. Together, Sections 27, 28 and 29 of the NWA are powerful legislative tools that allow for the customisation of individual water use authorisations according to prevailing local, regional or national dynamics and circumstances.

6.2 Principles

Equity, sustainability and efficiency are core principles of the National Water Policy that underpin the protection, use, development, conservation, management and control of water resources.

Water allocation will be done in terms of the priorities mentioned above in **Section 6.1.8** to ensure that water requirements for national growth and development, including water for strategically important uses, such as electricity generation are prioritised.

6.3 Objectives

Collectively, the principles inform the intended means to achieve WAR and its envisaged objectives as follows:

- **Redress race and gender imbalances:** A primary focus of water allocation processes is to redress past race and gender imbalances in water use and to support the reduction of poverty and inequity in the country.
- **Broad based black economic empowerment:** The water allocation process must contribute to broad-based black economic empowerment (BBBEE) and gender equity by facilitating access by black- and women-owned enterprises' to water.
- **Fair, reasonable and consistent.** The water allocation process must be undertaken in a fair, reasonable and consistent manner within the framework of the legislation and the constitutional imperatives.
- **Phased attainment of developmental and environmental objectives:** The water allocation process must give effect to the protection of water resources, as outlined in the National Water Act, by promoting the phased attainment of developmental and environmental objectives.
- **Reduction of administrative burden:** Mechanisms that reduce the administrative burden of authorising water use must be implemented. Current processes are often costly, very lengthy, bureaucratic and inaccessible to many South Africans.
- **Capacity development:** Water allocation processes must be supported by capacity development programmes that promote the use of water to improve livelihoods as well as the productive and responsible use of water by all users. These capacity development programmes must also help HDIs and the poor to participate actively and equitably in the process of informing the allocation of water. These capacity development programmes must be developed and implemented jointly between the DWA, the DAFF (and provincial departments of agriculture), the DTI and the Department of Rural Development & Land Reform.
- **Local, provincial and national planning initiatives:** The water allocation process must respond to local, provincial and national planning initiatives, as well as to South Africa's international obligations and regional SADC initiatives. In particular, the WAR programme must be aligned with the land reform and local economic development programmes.
- **Water quality considerations:** Where water is re-allocated from one sector or user to another, and where this reallocation could impact on the quality of the water resource, licensing of the waste discharge or non-point source impacts of the recipient should be considered.
- **Water for uses that are strategically important to the national economy:** As described in section 6(1)(b)(iv) of the NWA, such uses will remain a priority to enable national growth and development, as defined in Section 6.1.8.

The WAR and National Water Policy principles are given effect by various provisions of the NWA which, in its entirety, is a statute of reform and transformation.

6.4 Strategic actions

The critical strategic actions in this section will enable the acceleration of the water sector reform agenda in South Africa – to create and ensure sector stability in support of poverty eradication, reduction in inequity, socio-economic development and sustainable water resource use, and which are:

- Alignment with key government initiatives such as Land Reform and the Comprehensive Rural Development Programme.
- Establishing partnerships with key role-players and ensuring the effective involvement of relevant stakeholders (for example, sector charters such as the Mining and Forestry Charters) in the implementation of the WAR.
- Elevating the WAR programme to the executive level within the DWA to give impetus to its integrated and coordinated implementation.
- Legislative review to provide for the development of regulations for water equity purposes.

The activities that support these critical strategic actions are briefly described in the following paragraphs.

6.4.1 Formalising and accelerating implementation

WAR plans must be formalised and rolled out in selected areas that are prioritised according to water stress and opportunities for the re-allocation of water to historically disadvantaged communities and individuals. The potential for economic development and poverty reduction through WAR must also be a factor in the prioritisation of catchments.

The DWA will work with the Departments of Rural Development and Land Reform and Agriculture, Forestry and Fisheries (and provincial departments of agriculture) to achieve a coherent programme of land, water and agrarian reform.

A costed WAR implementation plan, based on experiences from the already-completed compulsory licensing processes, will be developed to ensure fast-tracked implementation of WAR across the country. Key activities include are listed hereafter.

6.4.1.1 Alignment with other government programmes

It is important to recognise that, in most cases, water is only one of a number of inputs required for economic growth and development. At the emerging productive level, access to a relatively small amount of water resource can make a substantial difference to the quality of life of the poor, but without access to other resources such as markets and transport infrastructure, it is unlikely that such access will enable people to truly escape from poverty.

Most sectors, as well as most national and sector strategies, now recognise that water is important and that no successful development can happen without water planning, development and the corresponding budget allocations.

To promote the beneficial use of water in the interest of all South Africans, the NWA defines a water allocation approach that should promote equity, address poverty, generate economic growth and create jobs. Water resources planning must be integrated into national, provincial and local planning and must be addressed in all growth and development strategies.

In addition to Local Economic Development, Integrated Development and Provincial Growth and Development Plans, the points below highlight some of the other key national strategies and plans, some sector specific, that must be integrated with water planning to achieve equity and poverty eradication objectives and outcomes.

National Development Plan (NDP) [4]

The National Planning Commission (NPC) has paid particular attention to water issues and how they impact on and influence our development pathways and opportunities. Water for basic needs and socio-economic development purposes is interspersed throughout the plan, which underlines its key role as an enabler to our social stability and economic prosperity.

Priority 1 within the NDP describes health and poverty as key issues for attention; both of which fall directly within the ambit of equitable water allocation and will be specifically addressed as part of the NWRS2.

In the section dealing with Social Protection (Chapter 11), household food and nutrition security and labour market policies (especially "incentives for employers and entrepreneurs in relation to job creation" and "reduced administration") are also especially relevant in the context of job creation and poverty eradication.

Intergovernmental support and cooperation, discussed in Chapter 13 (which covers building a capable and developmental state) has significance given the integrated nature and cooperative requirements of water allocation equity programmes for implementation.

Chapter 15 (Transforming Society and Uniting the Country) states that "South Africa needs to build a more equitable society where opportunity is not defined by race, gender, class or religion. This would mean building people's capabilities through access to quality education, health care and basic services, as well as enabling access to employment, and transforming ownership patterns of the economy. Redress measures that seek to correct imbalances of the past should be strengthened."

In dealing with nation building and "implementing redress, promoting economic and social inclusion, social cohesion, active citizenry and broad based leadership and the crafting of a social compact" the chapter concludes by stating that the "...plan is about transformation and contains recommendations to achieve a virtuous cycle of confidence and trust, a growing economy and broadening of opportunities."

Land reform and restitution programmes [5]

A key aspect of water allocations and use in fast-tracking WAR is its alignment to the Land Reform and Land Restitution Programmes, which relate to the recapitalisation and development support provided to black farmers and rural communities as land reform and restitution beneficiaries. In this regard, the Land Reform for Agricultural Development (LRAD) programme has specific relevance (see Section 6.4.1.5).

Comprehensive rural development programme

Water availability is a crucial input to the Comprehensive Rural Development Strategy. The NWRS2 makes provision for supporting rural development through the multiple uses of dams, investment in appropriate water infrastructure, water allocation reform and a programme of support to small-scale water users.

6.4.1.2 A better understanding of water use and water availability

There is a commitment to complete water use verification projects country-wide. Verification of water use is the process to confirm water use (the purpose of use, how much and where) and the lawfulness of the use. There are two parts to the verification process: existing lawful use (ELU) and current use. ELU refers specifically to water use entitlements that were authorised by previous laws in the qualifying period two years before the NWA came into effect.

[4] The Presidency, National Planning Commission. Our Future – Make it Work: National Development Plan 2030. Pretoria, 2012.
[5] Ministry of Rural Development and Land Reform. The Comprehensive Rural Development Programme Framework. Pretoria, 2009.

As an audit of raw water use, water use verification enables a number of critical integrated water resources management (IWRM) activities, including:

- Better and more effective local water management (across all water-use sectors), especially if these functions are delegated to, or performed by Water User Associations
- Improved management of water allocations during times of water scarcity and drought (fewer and better managed disputes among users)
- Local, regional and national water planning and allocations can be undertaken with greater certainty, especially where water is a critical input
- Confirmation of the lawfulness of water use especially on newly purchased land. Financial institutions require confirmation of lawful use before financing transactions
- Eradication of unlawful water uses. CME cases will have a clear factual basis for water use contraventions to be more effectively dealt with
- More efficient and accurate billing and improved water use revenue management
- Critical inputs into the WAR programme, since it confirms the availability of water for allocation and re-allocation required to achieve equity and redress
- Providing baseline information for compulsory licensing

The Department will accelerate the verification of water use and aim to ensure its comprehensive implementation in the next five years.

6.4.1.3 Undertake supporting preparatory processes

In addition to water use verification, two essential processes must also be implemented prior to the authorisation of water use by licensing, especially compulsory licensing. These are: Reserve determinations and water availability assessments. The processes around fast-trackingReserve determinations are dealt with in **Chapter 5**. Water assessment reports are part of the planning processes referred to in **Chapter 13.**

Compulsory licensing requires intensive, inclusive stakeholder engagement during implementation. In order to improve the inclusivity of the stakeholder engagement process and to impart information in relatively easily understandable formats, two reports will be produced the areas where implementation occurs:

- **Catchment assessment report:** A summary report that consolidates the status of water resources (including Reserve requirements, water availability assessments, supply-demand reconciliation options and WCWDM), water services, available and relevant local and regional planning initiatives (IDP, CRDP, LEDP and PGDP), local / regional economic assessments of water uses, opportunities for water allocations redress, and linkages with other reform initiatives (such as land and agrarian reform, BBBEE programmes).

- **Water allocation plan:** This plan describes the relevant principles and approaches that will inform the water allocation and authorisation processes in the relevant catchment and which forms the basis for all allocations and re-allocations.

6.4.1.4 Aligned support systems

The re-allocation of water is dependent on the efficient functioning of certain key systems within the DWA, particularly the following:

- **Water use authorisation (license) evaluation and assessment processes:** The water use authorisation processes must be implemented in order to achieve a streamlined and effective process that can support the allocation and reallocation of water.
- **WARMS:** The water authorisation and registration management system (WARMS) contains all the information on registered water uses across the country. Unfortunately, there have been challenges in keeping this information up to date. The validation and verification process will result in the updating and correcting of information on WARMS, but processes must be put in place to ensure that continual updating of water-use information takes place to keep WARMS. A critical element of this is ensuring that the transfer of ownership of land to which a water authorisation is attached requires information on the transfer of ownership to be provided to the DWA. This will require a legislative amendment.
- **CME:** Improved compliance monitoring and enforcement is required to support water allocation and water allocation reform to ensure that water is used according to authorisation conditions, and by legally authorised water users. This requires strong action to be taken against illegal water users.
- **Information and statistics systems** (geographic, socio-economic, trends monitoring, water use and users): Good information is important as a support to the allocation and re-allocation of water. The issue of monitoring and information systems is dealt with in Chapter 14 of the NWA.
- **Roll-out of the DWA rural livelihoods and food security programme:** The effective roll-out of the programme will contribute significantly to WAR through its impact on subsistence and small-livelihood enterprise water uses, especially in South Africa's rural areas.

6.4.1.5 Integration of land, water and agrarian reform programmes

In order to optimise the implementation of WAR, there is a critical need for integrating the water, land and agrarian reform programmes (see Section 1.3.1.1.2). This would ensure a matching of the required resources from each line-function department to support the relatively easier rollout of the respective programmes. Thus, there would be an enhancement of rural development and food security through the integration of the programmes in mobilising HDIs into the mainstream economy.

The following actions need to be undertaken as a means of achieving this integration:

- Establishment of task teams for planning the joint implementation of these programmes
- Preparation of collaboration, implementation and reporting protocols for the task team

- Assimilation or coordination of current structures to fully accommodate joint project implementation and reporting protocols
- Signing of Memoranda of Understanding to ensure commitment to the joint implementation mechanisms

6.4.2 Elevation of the WAR profile

To ensure the effective implementation of WAR, it is important to raise the profile of the programme and its linkages to broader government and private sector reform programmes. In this regard, the DWA will develop WAR Implementation Plans and ensure the consequent mobilisation of materials, resources and finances to realise programme implementation. This process will involve consultation with relevant government departments and stakeholder groups.

The DWA will also establish and ensure linkages with other government and privatesector initiatives, especially local and provincial development planning, land and mining reform projects and agricultural development support.

There will also be regular updates and general communiqués by the DWA on the WAR's implementation progress.

Establishing key role-player partnerships and stakeholder involvement

A key theme of the NWRS2 is that government cannot achieve the objectives on its own and that partnerships with other organs of state and with key stakeholders will be needed to achieve the objectives of the strategy.

The DWA, in a consultative process, will also determine specific race and gender water re-allocation targets for each project area, using the national WAR target as a baseline. Any deviation below the national target will have to be adequately substantiated. The national target is 30% water in the hands of South African black and women citizens.

The Water Allocation Reform Strategy

The strategic objective for the Water Allocation Reform Strategy (WARS) is to redress past imbalances in the allocation of water. The WARS stipulates national targets, which are inclusive of black and women users, to be progressively achieved. In terms of these targets, 60% of water available for allocation should be in the hands of black people, of which half should be in black women's hands. The reasoning behind setting up targets is to ensure that resources are channelled or focused to meet the objectives of the WAR programme.

In conclusion, the implementation of the provisions of this chapter should lead to a faster realisation of the equity principle described in the National Water Act and the Constitution of South Africa.

To achieve this, there is also the need for a review of the water policy to do away with water trading. The rationale for the abolishment of water trading is sufficiently articulated in the Emerging Policy chapter of this document.

Flowing from this policy review would be a legislative review meant to reflect the policy decision on water trading and to provide mechanisms for ensuring that unused entitlements are freed for equity purposes and contribution to economic development.

These are very much in line with the "use it or lose it" principle.

Finally, the WARS will be reviewed in light of current developments such as the latest Land Reform and Comprehensive Rural Development Programmes.

6.4.3 Water for uses that are strategically important to the national economy

As defined in section 6(1)(b)(iv) of the NWA, such water uses are critical to the country's national growth and development goals and sustaining the national economy and will continue to be a key priority. As previously declared, power generation remains such a use.

CHAPTER 7
WATER CONSERVATION AND WATER DEMAND MANAGEMENT (WCWDM)

As indicated in **Chapter 4,** a set of broad strategies need to be implemented to reconcile the available supply with the demand for water and water conservation and managing the demand for water is key to ensure sustainable use of our water resources, and to ensure that sufficient water is available for current and future requirements.

The National Water Policy (DWA, 1997) thus states that "Water resources shall be developed, apportioned and managed in such a manner as to enable all user sectors to gain equitable access to the desired quantity, quality and reliable water. Conservation and other measures to manage demand shall be actively promoted as preferred option to achieve this objective."

The National Water Act (Act 36 of 1998) therefore aims to achieve the desired balance between the development, use, protection, conservation, management and control of water resources. The National Water Act also recognises the pivotal role that WCWDM plays in water resource management with the objective of reconciling water supply and demand, and to enable all user sectors to gain equitable access to the desired quantity and reliability of water supply.

Water conservation

is the minimisation of loss or waste, the care and protection of water resources and the efficient and effective use of water.

Water demand management

is the adaptation and implementation of a strategy or a programme by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services and political acceptability.

Demands on South Africa's finite water resources are increasing, also increasing the competition between agricultural, industrial, power generation, mining, commercial and domestic needs. In order to meet these demands in a water-scarce country, all sectors must improve their water-use efficiency and conserve water.

The DWA has developed a National WCWDM Strategy, supported by three subsidiary strategies, focussing on water services, agriculture, and industry, mining and power generation. The Water Conservation and Water Demand Management Strategy is a fundamental step in promoting water use efficiency and is consistent with the National Water Act, which emphasises effective management of water resources.

The DWA has also been developing Reconciliation Strategies, of which WCWDM forms an integral part in balancing supplies and demands. Through these studies, targets to reduce the demand were set for all the major demand centres and WCWDM has been identified as the first step to be implemented in all other towns.

7.1.1 Growth and development goals

South Africa aims to build a transformed society where opportunities for a better life are extended to all its citizens. The NDP proposes that realising such a society will require transformation of the economy by bolstering competitiveness and investment in high value-added industries, increasing exports focusing on those areas where South Africa already has endowments and comparative advantage, such as mining, construction, mid-skill manufacturing, agriculture and agro-processing, and developing the tourism and business services. However, most of the sectors in which there are significant growth opportunities are water dependent.

- The NDP stresses that economic growth should be environmentally sustainable and that water conservation must be a priority to ensure sufficient water to support equitable economic growth and to support the achievement of the national developmental goals. Thus, all sectors of the economy need to prioritise water conservation in their development plans.

- The NDP states a dedicated national water-conservation and demand-management programme, with clear national and local targets for 2017 and 2022, and sub programmes focused on municipalities, industry and agriculture, should be developed between 2012 and 2015. Therefore, all sectors need to move with urgency in the implementation of WCWDM measures.

- The President of South Africa, the Honourable Jacob Zuma, in his 2010 State of the Nation address stressed that measures would have to be implemented to halve water losses by 2014. The NDP is also in support of the implementation of WCWDM in all sectors. Therefore, all sectors need to move with urgency in the implementation of WCWDM measures.

7.1.2 WCWDM in Local Government

Local Government or the water services sector's water use is estimated at around 23% of South Africa's consumption (including domestic and industrial use). Projections indicate that, together with industry, this is the sector with the largest expected future growth in demand, which will require continuous planning to balance supply and demand, thus making the implementation of WCWDM important. The Local Government sector offers the greatest opportunity for WCWDM due to the expected growth in water demand in this sector.

During droughts, some WCWDM measures are often enforced by local government through water restrictions; however, an appropriate municipal water control (metering) and pricing structure (billing and revenue collection) could ensure that these measures become routine.

- Municipalities contribute to water losses through poorly maintained infrastructure within their water reticulation networks and improper asset management. The adverse consequences of high water losses and high night flows (which can be as high as 70% or more) are that it reduces the availability of water, impacts on the capacity of water treatment works, reduces access to water for some and impacts negatively on the capacity and proper functioning of sewage works, for example.
- Illegal connections to municipal networks and connections to adjacent informal dwellings are found in many areas.
- A culture of non-payment for services has been developing over the past decades and this is continuing to a large extent. Where services are billed, a municipal flat rate is often charged because consumer metering is often non-existent.
- The sustainability of future water services will largely depend on the ability of municipalities to properly maintain the reticulation systems, to minimise household plumbing leakages and to maintain pressurised supplies (assurance of supply) to justify payment from their clients for those services.

Alignment with the Water Services Act

The Water Services Act, which governs water service provision and institutions that perform this function atlocal government level, requires that all Water Service Authorities prepare a Water Services Development Plan (WSDP). This is an important requirement for sustainable water supply, including the efficient management of the water value chain. Regulations promulgated in 2001 in terms of the Water Services Act, stipulate that water loss management initiatives must be reviewed annually and that the following should be implemented and reported on:

- Updated water balance (Regulation 11)
- Total quantity of water unaccounted for (now termed NRW)
- Demand management activities undertaken
- Measures implemented
- Progress made with the installation of water-efficient devices.

Despite the provision of the Act, many water reticulation systems show high levels of water loss due to many years of poor asset management and maintenance. The need for WCWDM in municipalities is critical and perhaps of the highest priority, even though this sector only uses about 23% of South Africa's fresh water resources. The water savings within this sector would go a long way in balancing the demand and supply within catchments.

Non-revenue water (NRW)

A study commissioned by the WRC (2012) on the status of non-revenue water found that only 132 usable data sets could be produced from 237 local and metropolitan municipalities in the country due to poor data and information management.

- The results from the study indicate that there has been a gradual increase in NRW over the past six years, with the figure now standing at 36.8%, (1 580 million m^3/a from an urban consumption of about 4 300 million m^3/a).This is on par with the rest of the world (world average of 36.2%). Water losses, however, are estimated at around 25% (about 1 080 million m^3/a).
- In many municipal water supply schemes the figures are even worse, with NRW up to 90%.
- In terms of a loss in revenue, these losses account for more than R7 billion/a.

This is unacceptable in a water-scarce country and municipalities will have to enhance their efforts to reduce water losses / non-revenue water to become financially sustainable and to manage South Africa's water resources sustainably.

Existing initiativeson WCWDM by municipalities

Despite the challenges mentioned above, it must be recognised that in many municipalities, considerable effort has been made to reduce water losses and non-revenue water. While there is a need to intensify efforts to conserve water and curtail demand within the local government sphere, many metropolitan and other municipalities have responded to the need to address water losses within their jurisdiction by developing strategies and business plans and are actively implementing WCWDM measures to reduce their water losses and improve water use efficiency.

Interventions being implemented include pressure management, retrofitting and removal of wasteful devices, improved management, sectorisation, metering, billing, development of by-laws, tariff reviews, mains replacement, leak detection and repair, awareness campaigns, asset management, operation and management, pressure management, and wastewater re-use.

While many municipalities have started with the implementation of WCWDM measures and others have made considerable progress, many municipalities still have to do much more in order to reduce their losses and to manage water efficiently.

The WRC has compiled a Compendium of WCWDM Interventions and Measures at the Municipal Level in South Africa, (WRC TT519/12), in which a number of success stories have been captured. The measures implemented ranged from zoning to pressure management. In one example, water use was reduced by 50%, resulting in cost savings of R29 million/a and a total saving of more than R130 million, (compared to a project cost of R9 million) and NRW reduced from 37% to 13%.

Reconciliation Strategies by DWA

The DWA has been investigating the potential for WCWDM in many water management areas through the development of Reconciliation Strategies. Through these studies, targets to reduce the demand were set for the major demand centres (metropolitan and other municipalities with large urban and economic centres).

WCWDM has also been identified as one of the first steps to be implemented in reconciliation studies such as the All Towns Studies. This is in line with protocols established within the NWRS1 in reconciling demand and supply. Some results from the Reconciliation Strategies are an assessment to determine the potential reduction in demand (and associated savings) was conducted for all the municipalities in the Integrated Vaal River system. Each of the municipalities were given a targeted saving, based on the individual assessments. The total potential saving for the Vaal River system amounted to about 200 million m^3 or 15% of the system input volume to be achieved by 2015.This study also indicated that about 95% of the potential savings would have to be achieved by the "big four" (the City of Johannesburg, City of Tshwane, City of Ekurhuleni metropolitan municipalities and Emfuleni Local Municipalitiy).

The City of Cape Town developed a long-term WCWDM strategy in 2007, which aimed to reduce the demand by 20% from around 800 million m^3 to 640 million m^3 through a number of interventions.

The Nelson Mandela Bay Municipality, within the Algoa Water Supply System and the largest user in the supply system, targeted a 37.5 Mℓ/d (or 13.6 million m^3 /a) reduction in demand over a five year period, having started in 2010.

The Amatole Water Supply System Reconciliation Strategy recommended a target of 1.2 million m^3/a for Buffalo City Metropolitan Municipality. This target has been set over an eight-year period, starting from 2012;

The Water Reconciliation Strategy Study for the Large Bulk Water Supply systems for the Mangaung Metropolitan Area, determined that the estimated potential water saving is 17.7 million m^3/a over a five-year period or a reduction of 20% in total consumption.

National target for reduction of water losses

In addition to the targets set through the Reconciliation Strategies, the President has set a national target to half water losses by 2014.

- Based on the WRC's NRW study annual water losses are estimated to be about 25% or about 1 000 million m^3 with a potential realistic reduction of 500 million m^3, of which halving the losses amounts to 250 million m^3.
- Considering that the biggest water users are the metropolitan and some large municipalities and that the biggest savings can be achieved by these municipalities, the focus has been on the largest metropolitan and larger municipal areas, while smaller rural municipalities where new grant funding such as the Municipal Water Infrastructure Grant is available, are also not ignored.

7.1.3 Irrigation

The agricultural sector accounts for approximately 60% of water utilisation in South Africa. It supports a significant portion of the South African economy and contributes massively to rural development. It assures food security for the country and contributes to job creation and employment throughout the food production value chain. Water conservation and water demand management must thus become entrenched in the agriculture sector.

- Many irrigation agricultural schemes experience water losses of between 35% and 45%. In the past, much of agricultural support tended to focus on issues relating to the repair of the infrastructure to ensure well-functioning irrigation schemes. Currently, however, many of these schemes are in a state of disrepair and some have exceeded their economic lifespans.

- The efforts to save water by this sector should be given high priority. A small percentage improvement in water use efficiency could result in a substantial reduction in water losses. In terms of water delivered on farms, all efforts must be made to use water efficiently from on farm storage, distribution systems, and in-field application supported by best management practices.

- The greatest potential impact of WCWDM in the agricultural sector can be achieved by addressing wastage from conveyance losses and the inefficient application of water. Water wastage is classified as water, intended to perform a specific task, but not used for that purpose due to losses in transit. Examples of water wastage in the agricultural sector are seepage from irrigation canals (which causes water logging of adjacent land), loss because of percolation, evaporation from land surfaces, or polluted return flows.

- Employing efficient irrigation systems is paramount in improving water use efficiency on farms, such as drip irrigation or, when managed and operated effectively, results in significant improvements in water use efficiency.

- Create an enabling environment to facilitate technology transfer about water use efficiency and productivity improvement technologies, such as the water accounting system (WAS) developed by the WRC for irrigation schemes.

- Improve scheduling of irrigation through the use of soil moisture content monitoring instruments (probes and wetting front detectors).

- The development of Water Management Plans by WUAs is central to implementing WCWDM in the agricultural sector. WMPs will be similar to the Water Services Development Plans (WSDP) currently developed by municipalities. Essentially, the process aims to conserve water, to improve water supply services to irrigation farmers and to enable them to use irrigation water more efficiently.

- The process involved in analysing current water use, setting targets for improved efficiency and planning a realistic means of reaching these targets is very important within this sector and should be given priority.

- The DWA is promoting and has initiated the development of water management plans by all irrigation schemes. A pilot project in 14 irrigation schemes has identified considerable reductions in water losses to be achieved, essentially through infrastructure asset management and operation. It is thus important that irrigation schemes develop water management plans.

7.1.4 Energy sector

Water and energy are recognised as indispensable inputs to modern economies. And, in recent years, driven by the three imperatives of security of supply, sustainability and economic efficiency, the energy and water sectors have undergone rapid reform due to the high demand of both energy and water. In order to produce water, energy is needed and vice versa. As a result, the water energy connection should receive more attention to ensure that policies that transition to a sustainable, low-carbon South African economy are achieved. A close look at water energy connections is critical for South Africa's sustainable development path.

- The energy sector in South Africa has been providing electricity in South Africa for many centuries, requiring considerable volumes of water for the generation of electricity. The energy sector's water requirement is about 2%. This may not appear to be a high consumption; however, considering there are only a few power stations, this is a relatively high water-consuming sector and implementing measures that will improve the overall efficiency of water use within the energy sector is critical.
- Most of the power stations were designed as high water usage, wet cooled and wet ashing power stations. Eskom has committed itself to the installation of dry cooled power stations that will drastically reduce the demand for water by these new power stations. The demand for water, however, would be increased due to the choice of air pollution measures selected to combat air pollution, as required by the National Environmental Management Act (NEMA) and there is scope for research and development for alternative, less water intensive technologies to be investigated by the power generation sector.
- There is scope for continuous improvement at existing power stations; for example, the implementation of hybrid dry and wet cooling systems which might require retrofitting of existing power stations to improve water efficiency. However, measures such as these would require retrofitting or even re-designing and would thus require careful planning.

A task team between the DMR and DWA to look at the options for renewable energy already exists (see Chapter 4 on hydropower generation).

7.1.5 Mining and industry

Given the diversity of industry and types of mining, the nature of water use in the industry and mining sectors is highly varied. If the water supplied to industries through the water services sector is included, this sector uses close to 16% of the total water demand in South Africa. The successful integration and implementation of WCWDM into operations and the creation of a water-wise business culture should be prioritised within the industrial and mining sectors.

Mining: As a result of the history of the mining sector it has in many ways been a foundation on which the modern economy of South Africa is built. A number of factors drive and influence future water demand, such as economic policies. In this regard, mining and the industrial sector are seen as key sectors that are expected to drive economic growth and water demand, thereby exerting more stress on water resources. With the mining industry expanding (particularly for coal and platinum), unavoidably, these new mines are located in water-scarce catchments. The implementation of demand-side management, among others, will contribute to the sustainable utilisation of water and reducing unnecessary abstraction of water.

Industry: South African industries range from the processing of agricultural and forestry products, construction, manufacturing (such as iron and steel), food processing, textiles, commercial industries, to tourism-related industries. Water supply to these sectors can be grouped into two broad categories: those that are abstracting water from a water resource and regulated in terms of the NWA (mainly mines, power stations and some industries) and those that are serviced (water supply and wastewater treatment) by water services providers (WSP), mainly commercial and most industries.

All industries use water in either their main or secondary activities, including office buildings. The use of water per unit output can range by order of magnitude within any one industrial sector and also between industrial sectors. In many cases, the range in water use within a sector is greater than the differences in water use even between sectors. However, there is considerable scope to implement WCWDM in the industrial sector, particularly for those industries that have not yet implemented water-efficient technologies and systems.

7.2 Principles

Managing the quantity and reliability (efficiency) of South Africa's water resources is to achieve optimum, long-term, environmentally sustainable social and economic benefits for society.

- Water conservation and measures to manage demand are implemented to actively apportion and manage water resources to promote equitable access to water use in desired quantity and reliability.
- The national WCWDM strategy provides the necessary linkage between WCWDM and Integrated Water Resources Management (IWRM). WCWDM is an integral part of the planning processes for water resources and water supply (to agriculture, domestic, industry, mines and power) and water services (local government).
- Water institutions strive to supply and use water in an efficient and effective manner by minimising water losses and promoting WCWDM to their consumers. Water institutions (including Water Services Institutions) ensure that they improve water use efficiency, reduce water losses in their systems and promote WCWDM to their consumers on an on-going basis.
- In line with the requirements of the National Water Act, water users in South Africa may not waste water and must use water efficiently.
- Partnerships and collaboration between private sector and public sector are adopted and strengthened to ensure the sustained implementation of WCWDM between sectors.
- Research and development ensures appropriate and efficient solutions are discovered and employed.

7.3 Objectives

- To ensure that all sectors use water efficiently and effectively and enhance existing WCWDM programmes across all sectors.
- To raise the importance and the need for a change of attitude and behaviour in terms of how water is treated and conserved to all South Africans through education and awareness programmes.
- To ensure that the recommendations from NWRS1 and WCWDM interventions are considered before infrastructure development projects are implemented as a means to reconcile supply and demand.
- To ensure that within all sectors targets are set and all water use sectors develop measures to use water efficiently and report on implementation of interventions.
- To align authorisation process with WCWDM priorities and encourage interventions to improve water use efficiency
- To strengthen capacity within DWA and the sector as a whole to implement WCWDM programmes through institutional development, training and capacity building initiatives.

7.4 Strategic actions

7.4.1 Ensure that relevant, practical interventions are implemented by all sectors

The DWA and the WRC have developed guidelines for municipalities to develop practical interventions for achieving WCWDM. The guidelines will be utilised to support implementation of WCWDM and implementation will be monitored through authorisation conditions, for example.

The elements of WCWDM shown in **Figure 8** (CJ Seago & RS McKenzie, 2007) indicate the benefits of implementing WCWDM activities and highlights some practical interventions for all sectors concerned.

7.4.2 Implement water allocation and water use authorisation that entrenches WCWDM

South Africa is a water-scarce country and this fact should be a central consideration in the water use authorisation process. This entails that WCWDM plans will have to be developed and submitted as part of water use applications. Individual water use applications should thus outline the extent water to which will be used efficiently and will be a key consideration in the authorisation process.

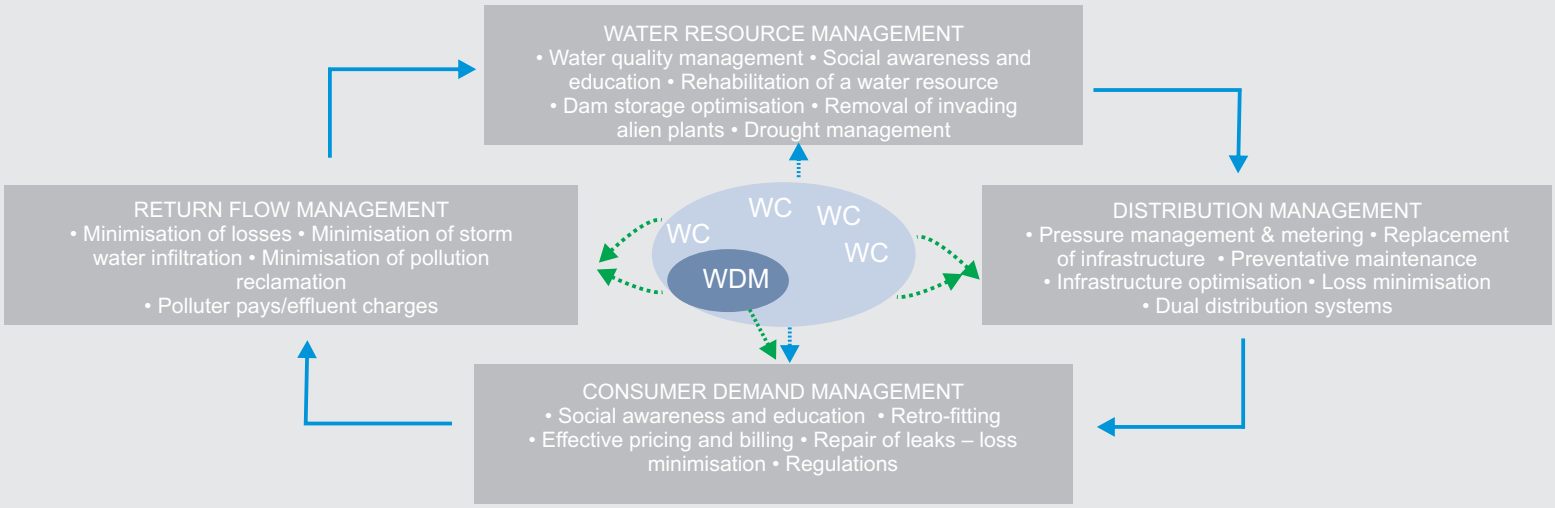


Figure 9: Elements of WCWDM

7.4.3 Strengthen compliance monitoring and enforcement

The monitoring and enforcement of the implementation of WCWDM measures through the NWA will receive enhanced attention over the next number of years. It is expected that, where conditions for water use have been set, such conditions will have to be implemented and the DWA will enforce compliance with such conditions. It is expected that water users will follow a path of continuous improvement in their water use efficiency, as indicated by:

- Where targets have been set, it is expected that users will report on the achievement of such targets and the DWA will monitor progress against meeting these targets.
- Monitoring and enforcement of compliance to regulations promulgated through water legislation, including the Water Services Act, will be given increased attention.
- Ensuring that, in the issuing of water use licences, WCWDM is considered for all water users. The NWA, for example, Section 29 stipulates that a responsible authority may attach conditions to every general authorisation or licence (iii) requiring the preparation and approval of and adherence to a water management plan.
- All sectors, agricultural irrigation schemes, local government, industry, mining and power generation should monitor and report, on a regular basis, on water loss and water efficiency improvements, such as water balances and measures implemented.

7.4.4 Implement water resource infrastructure development in the context of WCWDM

The protocol established within the NWRS1 must be implemented. It is crucial that priority be given to ensuring the efficient use of water and that alignment is obtained with the need for further infrastructure development.

NWRS1 protocol on water resources infrastructure

This protocol states that new water resources infrastructure will only be considered if sufficient WCWDM measures have been implemented as the first option in the provision of water. To enhance the efficient use of water, the first objective would be to avoid the use of water where possible, then to minimise the use of water by, for example, process optimisation, and the reiuse and recycling of water containing waste should be optimised, thereby optimising the efficient use of water.

7.4.5 Setting targets

Water use efficiency targets have been set in Reconciliation Strategy studies as a means to balance water supply and demand, having provided structure and guidance to the planning process as well as to the relevant sectors to implement the necessary measures to balance water supply and demand. Key areas that provide opportunities for water use efficiency are based on the understanding that water users in the sector must be measured and effectively managed.

Local Government: Investigations into the potential to reduce water demand by local government have been conducted through many water management area assessments and Reconciliation Studies, through which targets to reduce water demand havebeen set. The President has set a target to reduce water losses by half. Through information obtained from and in collaboration with municipalities and published through studies such as the WRC's State of NRW in SA (2012), municipalities are aware of their NRW status and must initiate measures to reduce their water losses/NRW. Continuation with target setting in the municipal sector would have little benefit.

The focus in the coming years is for municipalities to focus on the implementation of WCWDM measures to reduce their water losses and NRW. The targeted saving of halving the water losses was determined to be in the order of 250 million m^3/a, based on available information. Municipalities are required to report, on a quarterly basis, on their activities and the reduction of their water losses and NRW in terms of the outcomes-based performance management system.

Mining, energy and manufacturing industries: These are not homogenous and universal water use efficiency targets can thus not be set generically across the board. A project was conducted by the Water Research Commission in the 1980s to determine water usage by the high water-consuming sectors, resulting in the Natsurv series of documents. The DWA and WRC will be collaborating with the relevant sectors to revise these documents, including setting targets per sub-sector as far as is practically possible.

Agricultural sector: The NWA requires the development of Water Management Plans by irrigation schemes, which involve the analysis of current water use, the setting of targets for improved water efficiency and planning of realistic means to reach targets. It is thus critical to ensure that all water supplies and uses are measured and are part of irrigation agriculture. Therefore, the principle of universal water measurement for irrigation agriculture will be enforced as a priority action. This will be addressed in the revision of the Pricing Strategy.

7.4.6 Focus on leak repairs

There has been growing concern about the lack of action by municipalities to attend to high water consumption caused by water leaks in households. On average, it is estimated that by repairing plumbing leaks within the domestic sphere, consumers' consumption can be reduced from 200 to 300 cubic metres per month to 10 to 15 cubic metres per month (depending on occupancy). Municipalities should thus be driving the reduction of household leaks as part of their WCWDM programmes.

The DWA will support municipalities through:

- Strategic guidance on the implementation approach that involves community plumbers
- Development and identification of training programmes to support the leak repair programme
- Mobilisation of partnerships and support from the private sector in respect of technical expertise, funding, training and implementation
- Promotion of best practice, based on successful implementation within other municipalities

7.4.7 Develop an institutional capacity within the DWA to manage and regulate WCWDM effectively

The National Water Policy framework and the NDP have placed high priority on water conservation and water demand management and this requires that the DWA, the Department of Cooperative Governance (DCoG) and the South African Local Government Association (SALGA), among others, provide the necessary leadership and guidance to the sector.

The DWA needs to provide oversight, monitor and ensure that effective WCWDM measures are implemented across all sectors.

It is thus necessary that the DWA is appropriately structured at national and especially at regional offices, and that it is capacitated to be able to facilitate WCWDM in all sectors. The DWA will develop institutional capacity to manage and regulate WCWDM effectively.

7.4.8 Promotion of WCWDM through education and awareness-raising campaigns

Education and awareness-raising campaigns are important mechanisms to bring the need for WCWDM to the public and to trigger committed public actions and response. Social awareness is one of the key pillars of WCWDM and is essential for the balanced and sustained use of South Africa's water resources. Engagement with the public and stakeholders through media and other mediums will highlight important principles of the efficient use of water, to ensure that relevant information is shared and the public is educated and that the profile of WCWDM is heightened to achieve buy-in, involvement and accountability from citizens.

Various communication and awareness-raising mediums and approaches will be explored in a programme which will solicit and derive support and partnership from the private sector and other government departments and agencies.

Education and awareness is not the function of national government only; and all sector institutions, private sector organisations and civil society should be institutionalising the promotion of WCWDM.

7.4.9 Training and capacity building

The need to ensure sustainability through training and capacity building should not be overlooked, and training and capacity building will therefore be a strong enabler for the implementation of WCWDM measures. The essential element will be a systematic and long-term initiative to enable all users and regulatory institutions to develop competence in water resource management, including WCWDM. Different levels of training and capacity building initiatives will be identified to improve the capacity of the sector to implement effective WCWDM programmes within their institutions.

Institutions with various means and mandates will be engaged to provide support to advance training and capacity building, as outlined in the Skills and Capacity building chapter. The institutions will include the relevant SETAs, DBSA, WISA, SAICE and SALGA. **Chapter 15** covers the issues and interventions that will be implemented.

CHAPTER 8
INSTITUTIONAL ARRANGEMENTS

8.1 Context and current challenges

The National Water Act (Act 36 of 1998) provides for the establishment and transformation of institutions to assist the DWA in giving effect to its core mandate – the development, protection, conservation and allocation of water resources, and regulation of water services and water use.

Since the enactment of the National Water Act and the Water Services Act (Act 108 of 1997), an institutional framework for water resource management and water services has been established. Policy and legal issues within the water sector have hampered implementation of the institutional arrangements and highlighted the need for institutional realignment within the sector. In 2010, the DWA initiated an Institutional Reform and Realignment process to revise the institutional framework for the water sector to ensure that:

- Roles, responsibilities and accountability within the water value chain are better defined, to separate the policy making, implementation and regulatory functions.
- The number of institutions reporting to the Minister are rationalised and aligned to improve delivery, good governance, economies of scale, financial viability, transparency and accountability.
- The sector has sufficient institutional capacity to achieve its mandate and government outcomes and to improve water resource management and water services delivery.
- The institutional framework for the water sector is simple, clear and pragmatic.

This chapter presents the emerging models and seeks to provide an overall vision and strategic direction for the institutional framework for water resource management. It addresses the changes needed to enable water sector institutions to effectively contribute to Government's development and transformation objectives.

Clarity and certainty regarding future institutional arrangements in the following five strategic areas is urgently needed:

- Developing, financing and managing national water infrastructure
- Managing water resources at the local and catchment level
- Managing regional water infrastructure and supporting local government in the delivery of water services
- Managing local water resources infrastructure, supporting resource-poor farmers and transformation of the irrigated agriculture component of the water sector
- Regulation of the sector

8.1.1 Developing, financing and managing national water infrastructure

At present, the DWA manages most of the national water resources infrastructure through its Water Trading Entity while the Trans Caledon Tunnel Authority (TCTA) finances and project manages the implementation of economically viable water projects, as directed by the Minister. TCTA projects are financed off-budget and the investment costs are repaid through user charges.

It is recognised that the Water Trading Entity is not the most appropriate or efficient institutional arrangement for managing national water infrastructure. Thus, the intention is to establish an alternative and appropriate National Water Resources Infrastructure institutional model for developing, financing and managing national water infrastructure.

8.1.2 Managing water resources at the catchment level

Slow delegation of functions, with the associated authority and responsibility and delays in the transfer of funds, have impeded the effective functioning of Catchment Management Agencies (CMAs). Two CMAs are currently operational: the Inkomati CMA in Mpumalanga and the Breede-Overberg CMA in the Western Cape.

The Minister announced the establishment of nine CMAs in nine WMAs on 19 March 2012. The strategic interventions below address the establishment and functioning of the nine CMAs.

8.1.3 Managing regional water infrastructure and supporting local government in the delivery of water services

While most water boards in South Africa have been established for pragmatic reasons, and many have a history of good performance by both local and international standards, following are good reasons for change:

- Weak performance in the management of water supply and sanitation services by many municipalities, which compromises services
- Unclear responsibilities for water resources development at the local and regional level, and for regional bulk services outside of the existing water board service areas
- Governance and performance-related problems within some of the existing water boards

These problems are compounded by the municipalities having to report to DCoG and the water boards to the DWA.

Consideration is being given to the consolidation of existing water boards into Regional Water Utilities to manage regional water resources and regional bulk water and wastewater infrastructure in terms of a mandate from the DWA. This strategy would provide a rational basis for determining the number of Regional Water Utilities that should exist and the area of jurisdiction that they should serve in order to achieve optimum economies of scale.

Economies of scale will enable Regional Water Utilities to provide improved support to rural municipalities and to better deploy their limited financial and technical resources across disadvantaged areas. Economies of scale will also reduce the number of institutions that the Minister has to regulate and oversee.

8.1.4 Managing local water resources infrastructure and transformation in irrigated agriculture

The development and transformation of WUAs, either through the transformation of existing irrigation boards (to ensure broader representivity) or through the establishment of new WUAs comprising resource poor farmers, has been very slow. The transfer of the management of government water schemes to WUAs has been hampered by difficulties, including labour disputes in relation to conditions of service of employees.

Strategic interventions are envisaged to:

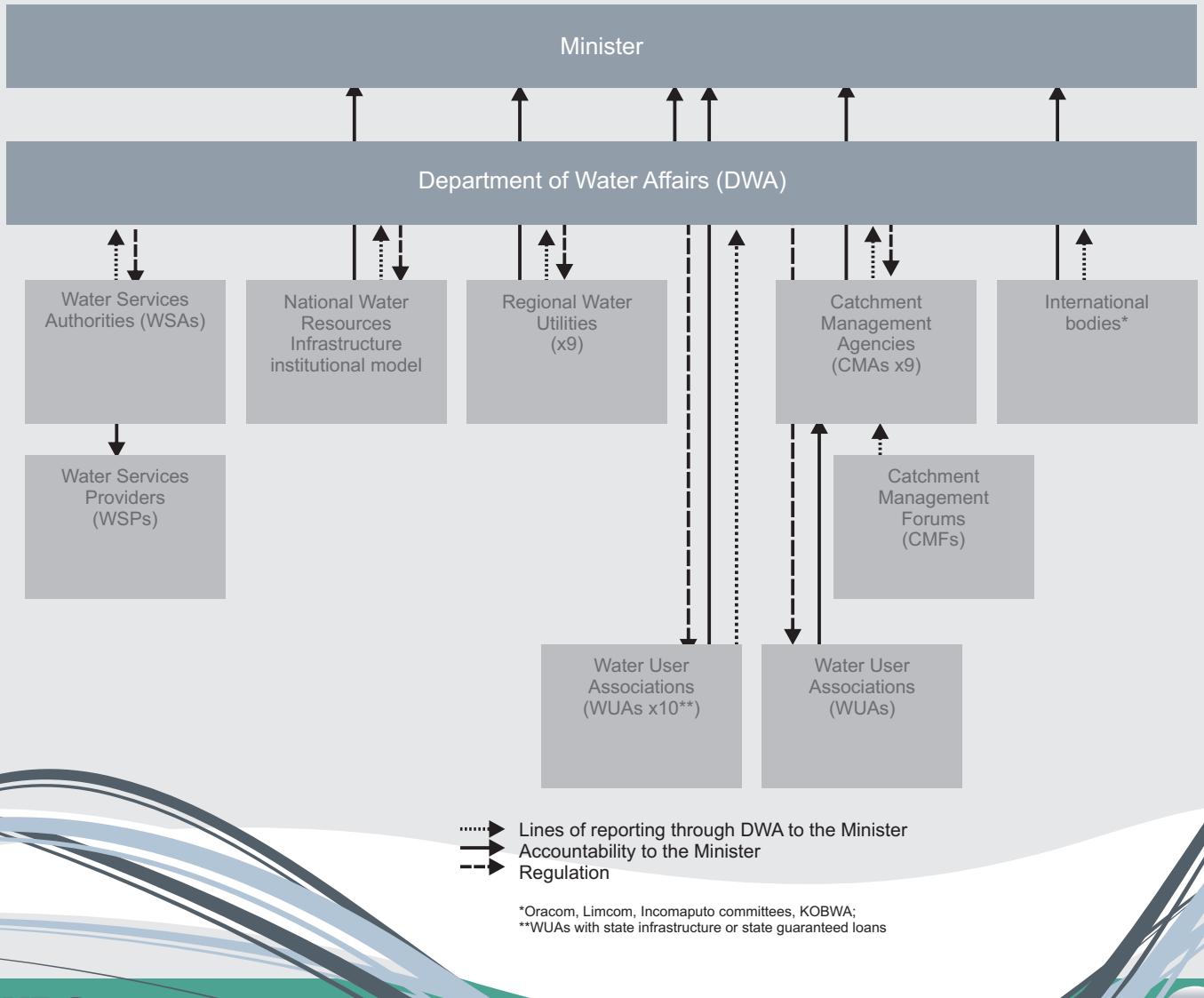
- Support the transformation of existing and the establishment of new WUAs to facilitate access to water for irrigation purposes by historically disadvantaged individuals.
- Enable the Department to effectively regulate and support the irrigated agricultural sector.

8.2 Vision

To ensure robust and sustainable water sector institutions that will:

- Ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons.
- Ensure and facilitate effective service delivery while supporting government's transformational objectives.
- Contribute to Government's national objectives and outcomes as articulated in the National Development Plan (2012) and the National Programme of Action for 2010-2014.
- Serve the public effectively and loyally, carry out their responsibilities with integrity, transparency, energy and compassion, through active co-operation, and contribute towards sustainable water management.

Figure 10: Institutional vision



8.3 Principles

- **Water resource management at the appropriate level:** The institutional vision provides for protection, use, development, management and control of water resources to be carried out at the appropriate level, considering efficiency benefits related to economies of scale.
- **Clear definition of roles and responsibilities:** The roles and responsibilities of the three spheres of government and of the envisaged water resource and water services institutions are clearly defined, with overlapping mandates being eliminated wherever possible. The imperative of co-operative government is recognised.
- **Coherence between national and local water related strategies and plans:** All water resource management and water services strategies, plans and instruments at local, regional and national level, must be aligned to achieve coherence.
- **Separation of regulatory and operational responsibilities:** There is a clear separation of the responsibilities and authorities for regulation of and operations in the water sector. WSAs, and all other users of water such as RWIs, WUAs and WSPs are not party to decision making in relation to water use authorisations. There is also a clear separation of regulatory (water use authorisation) functions from the operational (water user) functions. Regulation will seek to protect the integrity of the water resource and aquatic ecosystem for future sustainable use, while ensuring that water resources are made available for supplying the justifiable needs for growing and sustaining the socio-economy of the country
- **Collaboration and partnerships:** The importance of collaboration and partnerships between all stakeholders and beneficiaries is recognised, including between all spheres of government, the private sector and civil society.
- **Alignment:** Institutions will be aligned throughout the water value chain to ensure the efficient, equitable and sustainable protection, use, development, conservation and control of water resources and the provision of improved and sustainable water services, taking cognisance of the need to reflect the cultural, gender and racial diversity in South Africa. Realignment of institutions promotes economies of scope and scale in support of sustainability in the water sector.
- **Financial sustainability:** Realignment must enable institutions to leverage finance for water infrastructure and sustainable management.

8.4 Objectives

The following objectives will ensure a coherent institutional framework and guide the institutional realignment process:

- The Minister of Water Affairs exercises overall public trusteeship of the water value chain to ensure efficient and effective institutions within the sector. Through the Department of Water Affairs, the Minister sets policy for, regulates and provides support to water management and water services institutions to achieve their constitutional and legislative mandates.

- An appropriate institutional model for National Water Resources Infrastructure Management will be established to take responsibility for the ownership, financing, development, management and operations and maintenance of national water resources infrastructure by 2015.

- Nine capacitated regional water utilities will develop, finance, manage, operate and maintain regional bulk services (water and wastewater) by 2015.

- Nine viable CMAs undertake water resource management for each of the nine newly defined water management areas by 2016.

- WUAs, including transformed irrigation boards, effectively manage local water resources for the common interest of their members, particularly for historically disadvantaged groups. The transformation of irrigation boards to WUAs will be completed by 2015.

- WSAs effectively fulfil their water services functions.

- Bodies established in terms of international agreements effectively develop and manage the international river basins.

- An expert panel will be established to provide strategic guidance and independence in reviewing the tariffs while the DWA is finalising the project to determine suitable institutional arrangements for economic regulation from source to tap and back to source.

8.5 Strategic actions

Strategic interventions will take place to clarify the roles and responsibilities of the institutions with the water sector for water resource management and for providing water services.

8.5.1 The Minister – trusteeship of the water value chain

The Minister of Water Affairs, as the public trustee of water resources on behalf of the national government, has overall responsibility for all aspects of water resources management in South Africa. The Minister is responsible for ensuring aligned, efficient and effective water sector institutions to give effect to this responsibility and exercises authority over these institutions. The Act enables the Minister to delegate most of her or his powers and duties to departmental officials or holders of public office. The Minister acts through the Department of Water Affairs, which thus has full responsibility for the value chain.

The National Water Act (Act 36 of 1998) and the Water Services Act (Act 108 of 1997) set out the mandate under which the Department of Water Affairs operates. As the mandated public trustee of the nation's water resources, the Department of Water Affairs, acting with the authority of the Minister, must ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate.

In order to take full ownership of the water value chain, the DWA must provide decisive leadership and ensure that all components of the value chain function efficiently and effectively. The water value chain is illustrated in **Figure 11.**

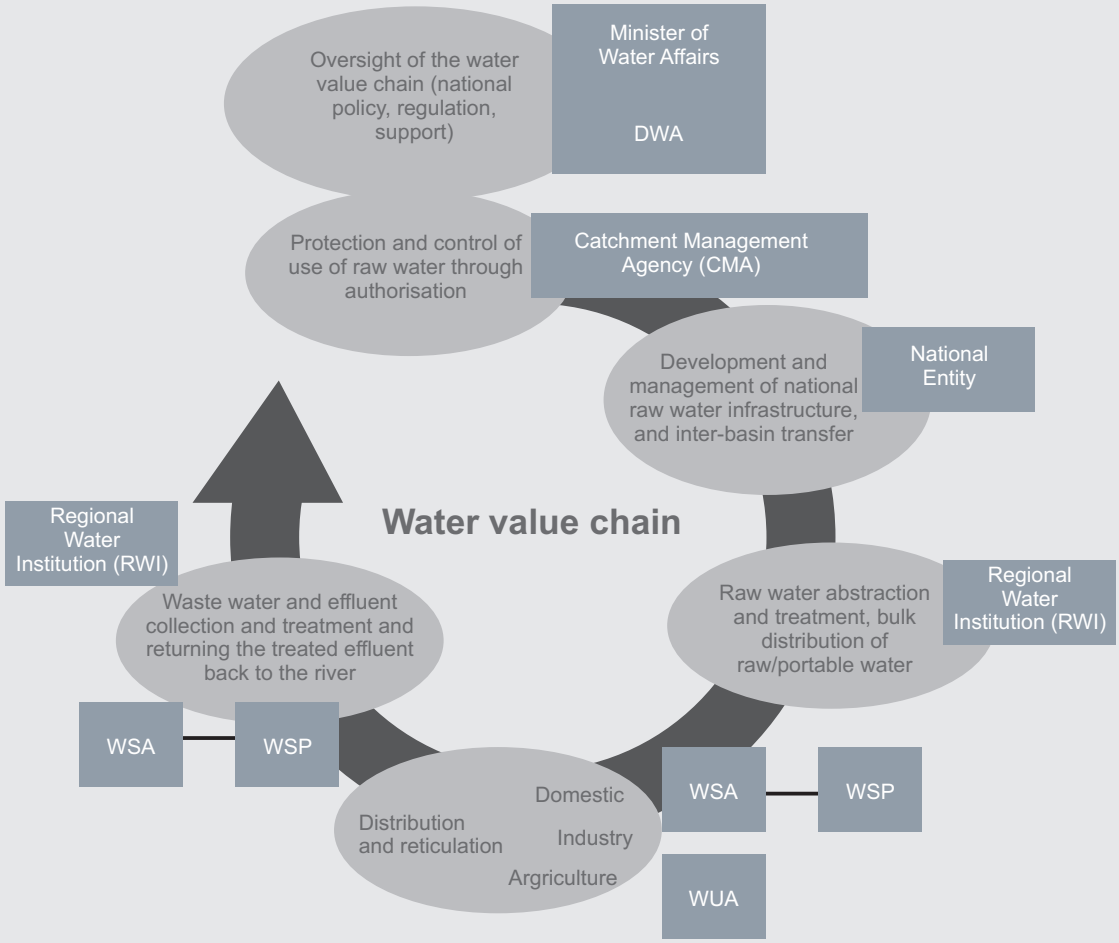


Figure 11: Water value chain

Following the institution-building and realignment process, the DWA will no longer be directly involved in the development, financing, operation and maintenance of water resources infrastructure, but will focus on policy development, strategic planning, regulatory oversight and support. Other competent institutions will be responsible for the implementation of water infrastructure. The DWA regional offices will provide institutional and technical support for WRM and WS and will fulfil coordination and auditing functions.

In fulfilling its leadership role and in taking full ownership of the water value chain, the DWA will set policy, regulate and provide support to water management and water services institutions to achieve their constitutional and legislative mandates in the water sector.

This role includes policy and leadership by:

- Providing strong sector leadership
- Developing and revising national policies
- Providing oversight of all legislation impacting on the water sector (including the setting of national norms and standards)
- Providing guidance on institutional roles and responsibilities
- Co-ordinating with other national departments on policy, legislation and other sector issues
- Promoting good practice
- Developing national strategies to achieve water sector goals

In discharging its sector leadership obligations, the DWA will:

- Engage institutions in government and across the water value chain to clarify mandates, roles, responsibilities, relationships and expectations at the interface between water resources and water services.
- Formalise intergovernmental cooperation arrangements between public sector institutions and agencies on the basis of core mandates.
- Strengthen collaboration on intergovernmental relations and public participation, through liaison with DCoG.
- Facilitate cooperation between the DWA, DCoG, and SALGA to improve the quality of municipal IDPs through the integration of policies, strategies and plans in WSDPs.

Regulation by monitoring sector performance, including conformity to national norms and standards, and making regulatory interventions to improve performance and ensure compliance.

Support by providing support to water sector institutions to fulfil their constitutional obligations in the spirit of co-operative governance. Support to local government entities will be co-ordinated with DCoG, considering DCoG's differentiated approach to recognise the unique circumstances of each municipality for assistance in financing and development planning.

Information management by managing the information required for support, monitoring, regulation and planning. In order to fulfil these leadership responsibilities, the DWA requires:

- Complete and reliable information
- Effective legislative and policy instruments
- Institutional capacity (human resources, management and monitoring systems);
- Funding
- Collaboration and partnerships with other key stakeholders in the water sector and elsewhere

8.5.2 Institutional model for national water resources infrastructure

National infrastructure is defined in the NWRS of 2004 as "schemes that are of wider importance (than local schemes) because they transfer water across national boundaries or between water management areas, serve multiple user sectors or large geographic areas, comprise several interconnected catchments, or serve a strategic purpose, such as the generation of electricity for the national grid".

National infrastructure will be ring-fenced and transferred to an appropriate institutional model for National Water Resources Infrastructure, which will optimise sector capacity for managing national water resources infrastructure operational by 2015.

Given the magnitude of this task, the DWA will adopt a phased approach to establishing the appropriate institutional model to ensure that associated risks are managed and mitigated. The DWA will also provide technical and financial support to ensure that the institutional model becomes sustainable as soon as possible.

TCTA will continue its present functions of financing and project managing the construction of water resources infrastructure that is funded off-budget. Once the institutional model is functioning in a stable manner, TCTA may be fully incorporated into the institutional model.

Immediate steps will be taken to turn around and improve the management of the national water resources infrastructure functions by the Infrastructure Branch of the DWA and of the related financial management aspects, which are the responsibility of the Water Trading Entity. It is intended that these functions, together with other important activities, such as hydrometry, certain monitoring functions, human resource management and information technology, will be merged into the institutional model for National Water Resources Infrastructure, which will run according to business principles.

[Government policy now allows for the establishment of government components inside a Government department[1]. These components' functions are conferred, assigned or delegated to them, subject to approval by Parliament.]

The primary role of the institutional model for National Water Resources Infrastructure will be to own, finance, develop, operate and maintain national water resources infrastructure in an efficient and effective manner to meet the social and economic needs of the country. In doing so, the objectives of integrated water resources management must be realised.

The institutional model will be empowered to contract Regional Water Institutions (see Section 8.5.3) or other competent institutions to operate and maintain national infrastructure on its behalf. Ownership of the infrastructure will remain with the national institutional model.
The institutional model will be empowered to undertake other tasks that are related to its primary function and that are specifically delegated to it by the Minister. These tasks, for example, may include:

- Development of public benefit water resource projects
- Dam safety rehabilitation
- Support to other institutions or projects that further the goals of government
- Operations of the institutional model will be funded through water use charges levied on water sales and the institutional model will be enabled to raise funds commercially for investment in water infrastructure.

The National Water Resources Infrastructure institutional model will liaise closely with the DWA and CMAs in planning and implementing water resource infrastructure development and managing the water resources. It is intended that CMAs will support the institutional model in respect of billing for water use and with revenue collection.

8.5.3 Regional water utilities

The 12 existing water boards will be consolidated into nine viable regional water utilities (RWU) to strengthen the development, financing, management, operation and maintenance of regional bulk water and wastewater infrastructure. Th

[1]Public Service Amendment Act, 2007 operationalised 1 April 2008 with the publication of Chapter 6 of the PSR)

The mandate of RWU will be expanded to include the development and management of regional water resources, regional bulk water services and regional wastewater infrastructure. They will be responsible for the financing, development, management, operation and maintenance of regional bulk water infrastructure in an efficient and effective manner to meet the social and economic development needs of current and future users to achieve the objectives of integrated water resources management. The RWU will also play a strong secondary role of supporting municipalities by providing water services on their behalf to users or by providing services directly to municipalities on a contractual basis, provided this does not detract from their ability to fulfil their primary functions.

The major functions of Regional Water Utilities will be to:

- Manage bulk water services infrastructure and supply bulk water to Water Services Authorities and their Water Services Providers, and to bulk water consumers
- Manage bulk sanitation infrastructure for wastewater treatment
- Operate existing regional water resources infrastructure
- Develop new regional water resources infrastructure
- Provide support to Water Services Authorities where appropriate
- Provide support to CMAs to undertake water resources management functions

In contracting with WSAs to provide affordable and sustainable water services in accordance with Section 78 of the Municipal Systems Act, Regional Water Utilities will be able to complement local government capacity through the benefits of economies of scale by integrating risk management and by leveraging finance for commercial water supply projects.

Regional Water Utilities may use water for any of the uses defined in Section 21 of the NWA, subject to them obtaining Water Use Licenses (WUL). Applications for such licences must be made to the DWA or a CMA and may be issued subject to appropriate conditions. The requirements of Section 27 of the NWA will be applicable.

Until existing water boards have been consolidated through the institutional realignment process, the Boards and other water institutions with the relevant capacity will continue to operate and maintain the existing water infrastructure systems.

8.5.4 Catchment management agencies – consolidating capacity

The National Water Act provides for the establishment of Catchment Management Agencies (CMA) to take responsibility for water resources management at a regional or catchment level. The role of CMAs is to ensure that water resources are managed in accordance with national policies, guidelines and standards in their jurisdiction, through the active participation of local communities and other stakeholders in the water resources.

In the 2004 edition of the NWRS, it was proposed that 19 CMAs be established to take responsibility for all of the catchments in South Africa. After assessment of the viability of the envisaged CMAs in respect of the availability and allocation of funding, capacity, skills and expertise for these water institutions, it is now intended to consolidate the 19 CMAs into nine CMAs.

To expedite the establishment of the nine CMAs, the intended adjustment of the boundaries of the Water Management Areas was published in Government Gazette number 35517 of 27 July 2012. The proposed nine WMAs are illustrated in **Figure 12** and are referred to as:

- Limpopo
- Olifants
- Inkomati-Usuthu
- Pongola-Umzimkulu
- Vaal
- Orange
- Mzimvubu-Tsitsikamma
- Breede-Gouritz
- Berg-Olifants

The boundaries of the proposed Water Management Areas consider catchment and aquifer boundaries, financial viability, coherence of interests of participating stakeholders, and equity considerations. As a result, these boundaries are not aligned with provincial or local government boundaries.

The advantages of reducing the number water management areas from 19 to nine are that:

- Management of integrated water systems, which were previously split across the WMAs, will be much easier
- Scarce technical skills can be better distributed between institutions
- Stronger revenue streams will give rise to more sustainable institutions
- Establishment of the CMAs can be achieved in a shorter time
- Larger CMAs can more easily cooperate and coordinate on regional, provincial and international levels as a result of being more substantial

Figure 12: Water management areas in which CMAs will be established

The larger CMAs will be better able to promote equity through more effective water resource management, greater responsiveness to the needs of poor and marginalised communities, and through closer links with stakeholder groups in their water management areas.

Stakeholder groups and communities will be empowered by CMAs by being involved in structures such as catchment committees, catchment forums and water user associations.

The NWA envisages that all water resources management functions, excluding those that have national strategic implications, should be delegated to CMAs. The functions to be delegated to CMAs will include:

- Water use authorisation
- Water resources protection
- Compliance monitoring and enforcement
- Coordination of water conservation and water demand management programmes
- Water quality management
- Establishment and oversight of WUAs
- Water resources planning
- Water resources information management
- Billing and collection of water use charges
- Coordination of disaster management

The rate at which these functions will be delegated to CMAs will depend on their ability to carry out the functions to the required standards. The DWA will assist CMAs to build capacity to carry out these delegated functions as soon as is practically possible.

The DWA will continue to have a significant role in ensuring that the voices of small users and disadvantaged communities are heard and in ensuring that the CMAs address redress
and equity as priorities.

The eight CMAs for which progress has been made with establishing their areas of jurisdiction and management structures will be disestablished and consolidated to align with the nine redefined water management areas. The Inkomati and the Breede-Overberg CMAs, which are already operational, will receive priority attention to be realigned into the Inkomati-Usuthu and the Breede-Gouritz CMAs, respectively.

The DWA will establish a dedicated high-level team to drive the establishment of the nine CMAs. A detailed programme will be developed for the progressive delegation of functions from the DWA to each CMA. Specific attention will be given to clear communication with affected water sector institutions and stakeholders concerning the powers and functions of CMAs. The realignment process and establishment of all nine CMAs is intended to be complete by 2016 when the CMAs must be operational.

8.5.5 Catchment management forums

Catchment Management Forums (CMF) are non-statutory bodies that may be established to democratise participation in water resource management and to support Catchment Management Agencies. They provide a potentially efficient and effective way to facilitate the coherent participation of stakeholders with diverse interests in decision making about water resources management. In this way, buy-in to water management strategies and their implementation, particularly Catchment Management Strategies (CMS), can be created.

CMFs are important structures for facilitating stakeholder representation in the establishment of CMAs and are envisaged to play an active role in assisting CMAs in carrying out their functions. CMAs thus have an obligation to support the creation and maintenance of CMFs and to ensure their participation in the formulation of the CMS. In this way, the intention in the National Water Act of ensuring responsible public participation in water resource management can be realised.

The DWA will support the establishment and functioning of CMFs until CMAs are established. Once CMAs are established, they will take the responsibility of providing support to the CMFs. This support will include financial support as appropriate, capacity building support, and access to knowledge and information to ensure effective participation and informed decision making.

A CMF may be established in one of the following forms:

- Non-statutory structure, with or without a Charter or
- Statutory body established in terms of the NWA, such as a Catchment Management Committee or an Advisory Committee

CMFs derive their strength and mandate from the stakeholders they represent. In order to build and maintain this strength, the primary focus of a forum should be on extending its stakeholder representation and building the capacity of stakeholders for meaningful participation, rather than attempting to gain authority through statutory means (that is, becoming formally established and receiving delegated functions). The role of a statutory organisation is different from a representative forum in that it becomes an agent of government, rather than a representative of key stakeholders.

CMFs may become an appropriate vehicle to foster cooperative governance between the CMA, local government and other stakeholder interest groups, in the interests of integrated management to support WRM. However, this implies that the organisations that are represented by the forum are both committed to the aims of the forum and support (and implement) the recommendations that the forum makes.

8.5.6 Water user associations

WUAs are established under the NWA which provides for these institutions to *"…operate at a restricted localised level and, in effect, be co-operative associations of individual water users who wish to undertake water-related activities for their mutual benefit".* This provides two clear principles for these institutions:

- that they operate at a localised level, and
- that they are established for the joint benefit, or common intent, of the association.
- WUAs effectively provide an institutional vehicle for three core functional areas.

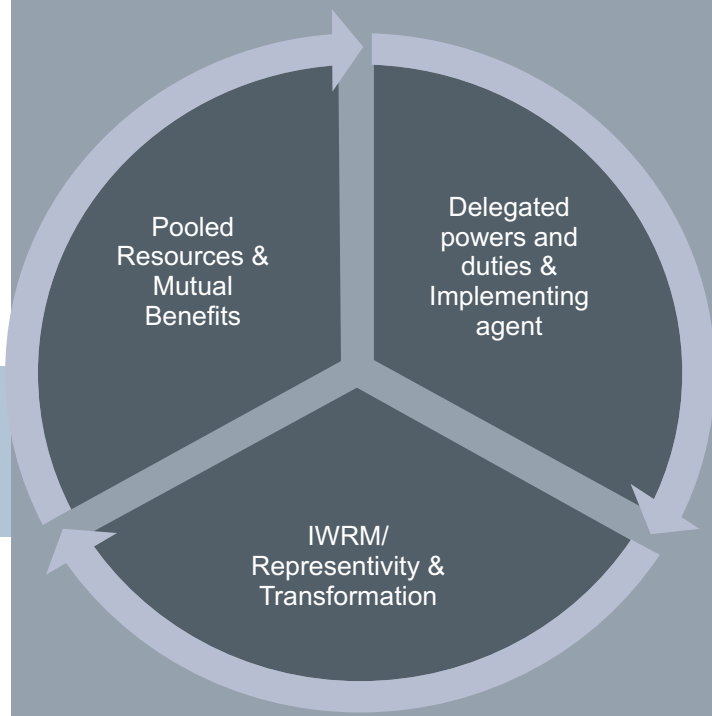


Figure 13: WUAs' institutional vehicle for three core functional areas

1. WUAs bring water users together to provide and manage water for their own intent and mutual benefit. As such, their role supports their water use as a key part of their economic activities and, therefore, supports their growth and development.
2. They provide a suite of roles that support localised water resource management, some of which are based upon delegated powers and duties as well as agency agreements.
3. They must as institutions established under the NWA, give effect to the overarching principles and spirit of the NWA, which includes the principles of integrated water resource management, representivity and transformation. As such, these institutions must serve a broader purpose of public interest.

WUAs can be established through three main pathways, each with a differing array of obligations and challenges:

1 A group of water users comes together to cooperate for the purposes of managing local water use, and establishes a new water user association. Approximately 40 new water user associations have been formed in this way since 1998.

2 A water user association is established to assume the operation and maintenance functions of a government water scheme. Approximately 10 WUAs have been established for this purpose.

3 An irrigation board (or group of irrigation boards) is transformed in a WUA. This process may involve the amalgamation of a number of irrigation boards and/or the inclusion of new members. Approximately 92 irrigation boards have been transformed into 50 water user associations and this has followed the Departmental approach to rationalise the number of institutions.

The Department has encouraged the establishment of multi-sectoral WUAs to ensure a more integrated approach at the local level. While some multi-sectoral WUAs have been established, the majority of new WUAs have been limited to supporting emerging smallholder farmers. Approximately 279 Irrigation Boards (IBs), Subterranean Water Control Boards and water boards were established for stock watering purposes in terms of the 1956 Water Act. Currently, there are 90 WUAs, including new associations and transformed boards. Approximately 129 boards still need to be transformed to become WUAs.

New WUAs may be established for any purpose; for example, mining, recreational purposes, use of groundwater, irrigation or multi-sectoral use.

The Department will support the establishment of new Water User Associations to build the capacity of emerging farmers in this sector to enable them to access subsidies in terms of the pricing strategy. The transformation of Irrigation Boards will be accelerated in a structured programme to ensure compliance with the transformational requirements of the developmental state and with the National Water Act. In this way, the management of local water resources infrastructure by users for their mutual benefit, and assistance with local water resource management functions, will be facilitated.

8.5.7 Bodies established in terms of international agreements

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

International bodies

- Joint Permanent Technical Committee (JPTC) - South Africa/Botswana
- Cross Border Water Supply Agreement - South Africa/Botswana
- Lesotho Highlands Water Project (LHWP)
- Permanent Water Commission (PWC) - South Africa/Namibia
- Joint Water Commission (JWC) - South Africa/Swaziland
- Joint Development and Utilisation of the Water Resources of the Komati River Basin
- Joint Water Commission (JWC) - South Africa/Mozambique
- Limpopo Watercourse Commission (LWC) - South Africa/Botswana/Mozambique/Zimbabwe
- Tripartite Interim Agreement - South Africa/Mozambique/Swaziland

The development and management of the four international river basins will be undertaken by River Basin Commissions, that is, bodies established in terms of international agreements.

The role of international bodies (in some cases called River Basin Commissions) is to foster sustained dialogue between countries, leading to cohesive and effective co-operative management and optimal utilisation of shared resources. These bodies/commissions provide focal points for the joint formulation of development plans for shared basins, co-ordination of joint basin studies and the collection and sharing of information. The international bodies/commissions are not water management institutions in terms of the Act. The responsibility for implementing jointly developed projects will normally remain with the domestic institutions. The bodies/commissions have an important role to play in promoting the implementation of regional water resource development projects (see **Chapter 11**).

8.5.8 Water services authorities

Water services authorities (WSA) are municipalities that in terms of Section 12 of the Municipal Systems Act have the constitutional responsibility for planning, ensuring access to and regulating provision of water services (water supply and sanitation) within their area of jurisdiction. WSAs may provide water services themselves or contract external Water Services Providers (WSP) to do this on their behalf. WSAs are responsible for securing from the DWA, or from a CMA where such functions have been delegated, licences to abstract water from and to discharge wastewater into a water resource. Regional Water Services Providers contracted to WSAs secure licences directly from the DWA or from a CMA.

WSAs have the responsibility to comply with the NWA with regard to water resources management as follows:

- WSAs have the right to use water for any of the uses defined in Section 21 of the NWA, subject to conditions that may be set by the relevant authority (either the DWA or the relevant CMA), including the provision of water services to its constituent.
- WSAs have the responsibility to apply for water use licences for any water use defined in Section 21 of the NWA in accordance with the procedure and requirements defined in the Act, specifically noting the requirements of Section 27 of the NWA.
- Where the provision of water services has been contracted to a WSP in terms of a service delivery agreement or contract, such agreement or contract should specifically determine who is responsible for application of water use licences. If no such provision is made in the agreement or contract, it shall be assumed that this responsibility remains with the WSA.
- As an owner, controller or occupier of land where an installation may cause pollution of a water resource, such as a wastewater treatment works and effluent discharge works, the WSA must take all reasonable measures to prevent pollution from occurring, as provided for in Section 19 of the NWA, and must comply with the conditions set in any licence permitting effluent disposal.

8.5.9 Water services providers

A water services provider (WSP) is defined as:

- Any person who has a contract with a WSA or another WSP to sell water to or accept wastewater for the purposes of treatment from that Authority or Provider, who is usually a bulk water services provider; or
- Any person who has a contract with a WSA to take responsibility for providing retail water services to one or more consumers within a specific geographic area; or
- A WSA that provides either or both of the above services itself.

In the case where water services provision has been delegated to a WSP by means of a service delivery agreement, the WSP is responsible for applying for and obtaining a water use licence.

8.5.10 Local water resource management responsibilities of local government

Local government is responsible for water services provision, but this function is dependent on the availability of water resources, water resource infrastructure and the sustainable management of water resources.

Some municipalities operate local water resource infrastructure (such as dams and boreholes) and bulk water supply schemes, as well as supply water and sanitation to consumers (households, businesses and industries), including wastewater collection and treatment systems.

Water services authorities are responsible for securing licences from the DWA (or CMAs, where they are established and where this function is delegated) to abstract water from and to discharge wastewater to the water resource. (Regional water services providers secure licences directly from DWA or CMAs.) Water services authorities are responsible for regulating the provision of water services within their local area through bylaws and contracts. They may delegate the responsibility for obtaining licences through contracts.

All local governments, irrespective of whether they are water services authorities and/or providers, are thus responsible for aligning their functions to water resource management functions and institutions.

This includes:

- **Monitoring to inform planning:** The basic building blocks of water services and water resources planning are the water services development plans (WSDP) and catchment management strategies (CMS), together with any other relevant plans.

- **Alignment of planning:** The planning of water resources, water supplies and regional or bulk infrastructure by water institutions within the supply chain should be aligned and integrated. This should be accomplished through **integrated water resources management,** which promotes the co-ordinated planning, development and management of water, land and related resources to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Water services development plans (and related business plans) must inform, and be informed by:
  - o catchment management strategies and the national water resource strategy, and
  - o water resource infrastructure plans.

- **Improving efficiency of water use:** To ensure the wise use of South Africa's scarce water resources through appropriate demand management and conservation initiatives, WCWDM must be considered as part of the water resources and water services planning process.

- Ensure alignment between water services regulation and water resources regulation: in terms of:
  - o licensing and regulation of water use, and
  - o licensing and regulation of waste discharge.

8.5.11 Advisory committees

The NWA empowers the Minister to establish Advisory Committees for different purposes and with different functions. Although primarily advisory in nature, such committees may also exercise any other powers that the Minister delegates to them. Advisory Committees are responsible to the Minister, who may make regulations concerning their terms of reference, membership, powers, duties and operation. The Minister has established the National Water Advisory Committee, in terms of Section 99 of the National Water Act (Act 36 of 1998) Although in most cases the establishment of an Advisory Committee is at the Minister's discretion, the NWA obliges the Minister to establish an Advisory Committee to make recommendations on the composition of the Governing Board of a CMA. This Advisory Committee must consult widely in the WMA to ensure that its nominations represent all relevant interests.

The Minister must have good reason not to appoint the members nominated by the Advisory Committee, but the Minister may appoint additional members to the Governing Board to ensure full representation and the availability of sufficient expertise on the Board for it to carry out its duties.

8.5.12 The Water Tribunal

The Water Tribunal, established in terms of the NWA, is an independent body with a mandate to adjudicate appeals on a wide range of water-related issues, mainly against administrative decisions made by responsible authorities and water management institutions. The Tribunal also adjudicates claims for compensation where a user considers that the economic viability of her or his water use activity has been severely prejudiced by

- a refusal to grant a licence, or
- a reduction in water use when a licence is granted or reviewed.

However, some alleged breaches of administrative justice will be adjudicated by the courts in terms of the Promotion of Administrative Justice Act. The Tribunal has jurisdiction throughout the country and holds hearings in the areas where the cause of action arose. Its operations are funded from the National Treasury.

The process to amend the NWA will review the governance arrangements of the current Water Tribunal.

8.5.13 Water Research Commission (WRC)

The Water Research (Act 34 of 1971) provides for a Water Research Commission (see **Chapter 14**).

8.6 Strategic actions

- An appropriate institutional model for National Water Resources Infrastructure Management will be established to take responsibility for the ownership, financing, development, management and operations and maintenance of national water resources infrastructure by 2015.
- Nine capacitated regional water utilities will be established to develop, finance, manage, operate and maintain regional bulk services (water and wastewater) by 2015.
- Nine viable CMAs will be established to undertake water resource management for each of the nine newly defined water management areas by 2016.
- The DWA will support the establishment and functioning of Catchment Management Forums until CMAs are established. Once CMAs are established they will take the responsibility of providing support to the CMFs. This support will include financial support as appropriate, capacity building support, and access to knowledge and information to ensure effective participation and informed decision making.
- A new policy vision for water user associations is being finalised.
- The transformation of Irrigation Boards will be accelerated in a structured programme to ensure compliance with the transformational requirements of the developmental state, together with the amendment of the National Water Act.
- An expert panel will be established to provide strategic guidance and independence in reviewing the raw and bulk water tariffs, while the DWA is finalising the project to determine suitable institutional arrangements for economic regulation from source to tap and back to source.
- The process to amend the NWA will review the governance arrangements of the current Water Tribunal.

CHAPTER 9
REGULATION OF THE WATER SECTOR

9.1 Context and current challenges

9.1.1 Context

Regulation of the water sector and of the use of water is a critical element of effective, equitable and sustainable water management of water resources and the delivery of sustainable and appropriate water services.

Regulation and oversight

Regulation aims to change the behaviour of water users and water institutions to ensure the sustainable and equitable use, protection, conservation, and development of the nation's water resources. The Minister, as a shareholder in a number of water sector institutions, plays a role in providing strategic guidance and oversight to these organisations, which is different from the regulatory role of various organs of state.

The DWA regulated water use even under the 1956 Water Act through, for example, issuing water permits, setting discharge standards, and regulating dam safety. Under the National Water Act, the scope of this regulatory role has expanded considerably.

In addition, there are a now number of organisations involved in the regulation of water, as shown in **Figure 14,** with different roles and responsibilities spread across this wide range of functions.

Nonetheless, in relation to water resources, the DWA plays the major role, although elements of these regulatory functions will be transferred to CMAs in due course. The DWA's mandate is derived from the Constitution, the National Water Act and the Water Services Act.

Successful implementation of the broader scope of regulation under the NWA remains a challenge that must be addressed by the DWA and other water sector institutions over the next period.

The scope of water regulation encompasses:

- **Water use authorisation:** to ensure the equitable and sustainable use of water in the public interest. Water use may be authorised (or permissible) in terms of Schedule 1 of the NWA, a general authorisation, an existing lawful use, or in terms of a water use licence.
- **Drinking water quality and wastewater discharge regulation:** which ensures minimum standards for drinking water provision and for wastewater discharge, regulated through programmes such as the Blue Drop and Green Drop certification programmes and through national minimum norms and standards.
- **Infrastructure regulation:** to ensure that water infrastructure is functional, properly operated and maintained, appropriate for present and future needs, meets public health and safety standards and is sufficiently durable for a realistic economic life expectancy. This includes dam safety regulation to ensure the on-going protection of public health and safety in relation to dams with a hazard potential.
- **Regulation of corporate governance:** in water sector institutions to ensure compliance with legislation and rules that govern the behaviour of organisations and functionaries in the public sector, such as the PFMA, MFMA, National Treasury directives, and the King Codes of Conduct.
- **Regulation of qualification:** to ensure that process controllers and other functionaries responsible for operating water and wastewater works have the requisite skills and that courses offered by training institutions are accredited to the appropriate standards.
- **Regulation of competition:** to ensure fair competition where appropriate.
- **Economic and social regulation:** to ensure that pricing is appropriate and pro-poor while still ensuring sufficient funding from revenue and the fiscus to maintain appropriate service standards and sustainable infrastructure.

9.1.2 Progress in regulation

Significant progress in a number of these areas has been made as demonstrated by:

Water use authorisation

- The DWA has largely removed the backlog of licence applications that has been delaying legal water use over a number of years.
- The DWA has registered all raw water users in South Africa, even though there are challenges in ensuring the accuracy of this data.
- Verification of existing lawful uses is in progress across the country.
- A number of illegal water users and polluters have been criminally prosecuted.

Drinking water quality and wastewater discharge regulation

- Norms and standards for water services have been Gazetted.
- The Green Drop and Blue Drop programmes, which include water and wastewater quality monitoring, reporting and compliance certification, have substantially improved the quality of drinking water and the quality of municipal wastewater discharges.
- The Regulatory Performance Management System, initiated in the 2007/08 financial year, monitors the performance of water services authorities against the key performance indicators provided in the Strategic Framework for Water Services.

Infrastructure regulation

Large water infrastructure is regulated under DEA requirements.

Dam safety regulation
There is an on-going programme of inspections of dams with a safety risk. The DWA undertakes remedial work on departmental dams requiring such, while remedial work on other dams (including private dams) is undertaken by owners of dams that do not comply with one or more of the many safety criteria set in the Dam Safety Regulations.

Economic and social regulation
- A pricing strategy for raw water use has been Gazetted, implemented, and is being reviewed.
- Norms and standards for water services tariffs have been Gazetted.
- A project to determine suitable institutional arrangements for economic regulation from source to tap and back to source has been initiated.
- The DWA has undertaken a compliance survey of municipality water services tariffs against the relevant norms and standards. This survey indicates that almost all municipalities provide free basic water and use stepped tariffs that are pro-poor and promote water conservation.

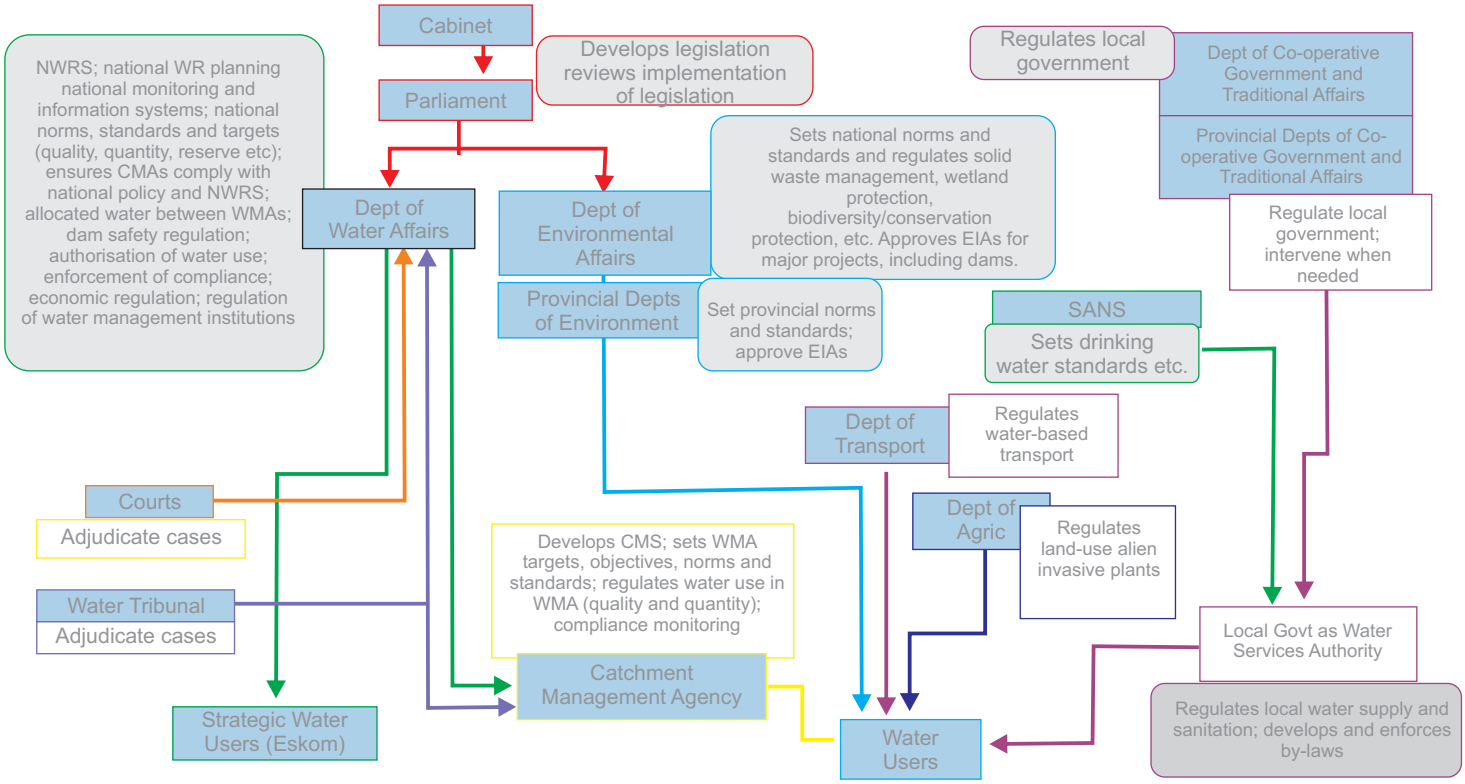


Figure 14: Roles and functions of the organs of state in the water regulatory process

9.1.3 Challenges
Despite the progress, there are still a number of challenges facing the regulation of water use in the country.

Water use authorisation and compliance
While DWA has managed to significantly reduce the backlog in water use licence applications, there is a challenge in streamlining the process to ensure and maintain an efficient, equitable and effective authorisation process and to prevent a new backlog from developing.

Limited capacity to ensure compliance with authorisation conditions has led to high levels of illegal water use, and pollution from various sources, including from municipal wastewater treatment works.

There is a major challenge in ensuring the accurate and up-to-date capturing of water use information on the WARM system.

Validation and verification, which is necessary to provide an accurate database of water use to support regulation, is not yet completed and is proving to be a slow and resource-intensive process.

While compulsory licensing has been completed in three catchments, the overall process has been slow and is resource intensive and complex.

A large percentage of water use is authorised as existing lawful use in terms of the previous Water Act (1956), and is not subject to the same conditions that would be applied if this water use was licensed in terms of the National Water Act.

Illegal water abstractions, especially by irrigation farmers present serious problems.

Acid mine drainage (AMD) is a major source of pollution that results from water use practices that were allowed when less stringent conditions were imposed on mine discharges prior to promulgation of the National Water Act. However, AMD offers an opportunity in that it can become a valuable additional water resource if properly treated and managed.

The proposed mining of gas using hydraulic fracturing techniques, referred to as fracking, can to bring enormous economic benefits to South Africa. However, hydraulic fracturing is said to pose a threat to groundwater and to the environment, which has sparked calls for strict regulation. This may entail declaring fracking a controlled activity in terms of the NWA. Exploration is currently on shale and coal.

Drinking water quality and wastewater discharge regulation
There is ongoing pollution of water resources by effluent discharged from malfunctioning municipal wastewater treatment works, and there have been problems with drinking water quality in a number of towns.

Regulation of qualification
While work has been done on the qualifications required for water treatment works operators, the regulation of qualifications for operators and officials in the water sector must be expanded to other critical positions.

Economic and social regulation
While economic regulation is an important component of regulation in the water sector and receives substantial attention internationally, particularly in the water services sector, it is a neglected area in the South African context. The current institutional arrangements of the economic or price regulator do not lend themselves to a clear separation of the policy and regulatory roles.

Water use charges and water tariffs do not fully achieve their objectives. Prices for raw water have been kept artificially low, which means that the aggregate of revenues collected from the sale of raw water does not cover the cost of supplying the water. Under these pricing conditions the maintenance of infrastructure and the ability to build new infrastructure for augmenting supplies to meet growing water needs has suffered (see **Chapter 1**).

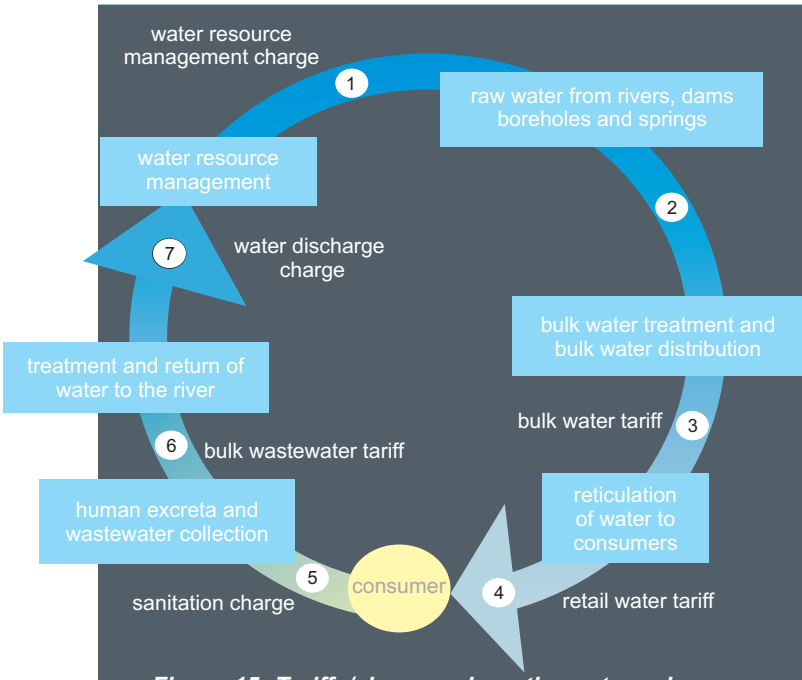


Figure 15: Tariffs/charges along the water value chain

9.2 Principles

The key principles of regulation are listed below.

- **Equity:** Regulation across the water chain must promote equity in access to water.
- Administratively fair and just procedures: Adherence to transparent decision making and due process requirements that allow for public participation and accountability towards all stakeholders.
- **Predictability:** Provide reasonable certainty as to the principles and rules that will be followed in the regulatory framework.
- **Minimal regulation:** Regulatory intervention should be the minimum necessary to deal with the matter being addressed and should avoid unnecessary administrative burdens on regulatory and regulated bodies.
- **Transparency:** Regulatory outcomes should be easily accessible (published).
- **Information based:** Water resource, water services and institutional information must be publicly available and up to date.
- **Appropriate institutional operating framework:** A separation of operational and regulatory functions to achieve the optimal degree of independence. Absolute independence is seldom possible. The regulatory body must have the capacity to consistently perform professionally, competently and conscientiously.
- **Capacity:** All regulatory bodies must have adequate capacity and capability to formulate an effective regulatory framework, and to implement effective regulation. Equally, the regulated bodies need sufficient capacity to respond effectively to the regulatory requirements.
- **Comprehensive regulation:** Regulation should be comprehensive, extending over the whole value chain, covering water resources, water use, pricing (tariffs), water services standards and discharge standards.

9.3 Objectives

The primary objective of regulation is to continuously improve compliance by water users and water institutions with rules and authorisations, which can result in:

- Contribution to the achievement of government objectives, including equity in water allocation and access to water for socio-economic development to redress race and gender imbalances of the past, and to reduce poverty and inequality.
- The protection of water users.
- Compliance with drinking water quality standards to safeguard and enhance the health of people in South Africa.
- The protection of resource quality and the integrity of water ecosystems.
- The prevention of water-related disasters wherever possible.
- Financially sustainable and well governed water institutions.
- Water use charges and tariffs that are set at appropriate levels with users and consumers paying the bulk of the costs for economic infrastructure and services, with appropriate protection for poor households.
- Investor certainty and incentives for new investment in water infrastructure.
- Water infrastructure that is operated efficiently, is properly maintained and remains fit for purpose for the full design economic lifespan.
- Dams that are well maintained and operated, posing negligible risk to public health and safety.

To achieve this, the DWA will implement an integrated and targeted regulatory strategy that focuses resources on critical and priority areas requiring regulation and that co-ordinates the regulatory capacity and authority in the sector. The strategic actions outlined in the following section are key elements of this targeted strategy.

9.4 Strategic actions

9.4.1 Amendment of water legislation

The DWA is driving a process to amend the legislation governing water services and water resources to facilitate the achievement of the objectives of government including accelerated equity in access to water. The revised legislation will clarify the role of the Water Tribunal, the appeal process, and strengthen the regulatory role of the DWA in relation to water services and water resources.

9.4.2 Regulatory framework

The DWA will develop a comprehensive regulatory framework that will guide the equitable and sustainable regulation of the entire water value chain and that will incorporate the existing water services regulatory strategy.

9.4.3 Equitable and effective water use authorisation

In the consideration of authorisation of water use, equity in access to water will be a primary concern. The DWA will call for compulsory licensing in stressed catchments to ensure equitable allocation of water and to impose appropriate conditions across these catchments.

The DWA will accelerate and streamline the water use authorisation process by:

- Establishing a single authorisation process between the DEA, the DMR, and the DWA, as well as a joint compliance monitoring and enforcement programme between the DEA and the DWA.
- Accelerated delegation of regulatory functions to CMAs which, will progressively take over regulation of water use at the catchment level. The accelerated establishment of CMAs is discussed in **Chapter 8.**
- Accelerate its on-going programme of verification of existing water use.

The DWA will, in co-operation with the DMR and the DEA, augment the current regulatory framework to ensure that the appropriate regulations and controls are in place for the protection of water resources should shale gas or coal-bed methane be extracted through a hydraulic fracturing process.

The DWA will develop regulations that will require the measurement of water abstracted from the resource for irrigation use and regular reporting on the quantity of water used.

9.4.4 Compliance and enforcement

The DWA will strengthen its compliance monitoring and enforcement capacity to take strong action against illegal water use in accordance with the enforcement protocol. The DWA will also develop and ensure compliance with norms and standards for various water resource development options and strategies, such as groundwater management, rain-water harvesting, desalination, and water re-use, to provide guidance to the sector.

The DWA, CMAs and WSAs will develop and implement a targeted discharge regulatory strategy focused on ensuring compliance with discharge standards by high-impact wastewater dischargers, including the regulation of discharges from municipal wastewater treatment works, mines and other high-impact users.

9.4.5 Drinking water quality and wastewater discharge regulation

The DWA will revise the national standards for the provision of water services and liaise with the DCoG to ensure that WSAs develop, promulgate and implement water-related bylaws in compliance with national norms and standards. The DWA will also enforce compliance with Section 18(2) of the Water Services Act, which requires WSAs to report annually on the implementation of their WSDP and on a water audit.

The DWA will develop and implement a coherent Non-Point Source Strategy focused on improving the management and regulation of NPS contributions to priority water-quality problems by streamlining existing legal requirements, adopting innovative ways of regulating NPS and strengthening co-operative governance mechanisms for NPS management.

9.4.6 Regulation of corporate governance
The DWA will regulate water management and water services institutions, such as CMAs and water boards to ensure good corporate governance of these institutions.

9.4.7 Regulation of qualification
The DWA will liaise with the SETAs to set standards for qualifications for process controllers and for other functionaries in the water sector.

9.4.8 Economic regulation
The DWA will formulate an appropriate institutional design for economic regulation of the water sector, with a clear separation of regulatory functions from those of policy development and operations for which the DWA is responsible. The DWA will also revise the Water Use Pricing Strategy for water use charges to encourage efficient water use.

The DWA will implement the Waste Discharge Charge System, initially in three pilot catchments, monitor the success of the system and compile guidelines for implementation elsewhere. The WDCS will then be implemented in other priority catchments.

In consultation with SALGA, SAAWU and other relevant departments, the DWA will revise the Norms and Standards for water services tariffs, separating tariffs for water supply by municipalities, for sanitation services by municipalities and for bulk potable water supply by water boards.

The DWA will revise the policy and regulations to expand the current subsidies for resource poor farmers to include support to rural development more broadly.

9.4.9 Regulatory coordination
The DWA will promote co-operation between water institutions and other departments, such as National Treasury and the DEA, to ensure a coordinated approach to water use authorisation, compliance monitoring and enforcement. The DWA will also promote co-operation between SADC member states to ensure regulation in shared river basins achieves basin-level objectives.

Civil society will be encouraged to play a watchdog role in supporting compliance by water users with water regulation at all levels.

9.4.10 Information system and information publishing
The DWA will develop a functional monitoring and information management system to give access to high-quality information to support effective regulation of water use (See **Chapter 12**).

9.4.11 Combatting of corruption
The DWA will deal decisively with all forms of fraud and corruption.

CHAPTER 10
MANAGING WATER RESOURCES FOR CLIMATE CHANGE

10.1 Context and current challenges

Climate change is expected to have a major impact on South Africa, with resulting consequences for people, the economy and ecosystems. Water is the primary medium through which the impact of climate change is going to be felt in South Africa.

Climate change in South Africa will result in changing rainfall patterns, the intensity of storms and the extremes of droughts and floods; increasing evaporation; changes in soil moisture and runoff and thus water availability; changing water quality conditions (including temperature of aquatic systems) and increasing climate variability.

10.1.1 Climate Change and development challenges

Climate change is one of five critical trends noted in the National Development Plan, which recognises that "South Africa is not only a contributor to greenhouse gas emissions – it is also particularly vulnerable to the effects of climate change on health, livelihoods, water and food, with a disproportionate impact on the poor, especially women and children. While adapting to these changes, industries and households have to reduce their negative impact on the environment. This will require far-reaching changes to the way people live and work." (NDP, 2012)

The NDP recognises that the impacts of climate change will be felt substantially in the water arena, and reflects the need to build economic sustainability and resilience to "enhance the resilience of people and the economy to climate change."

South Africa has low rainfall and high evaporation rates, while rainfall varies significantly from year to year and across the country. This poses major challenges to economic development and livelihoods.

Both agriculture and urban-industrial areas in many parts of the country have experience floods and droughts in the past. While South Africa's water infrastructure and management capacity assist in adapting and responding to this variable climate, climate change is expected to exacerbate this variability with significant hydrological, ecological, social and economic consequences.

Climate variability refers to natural variability in the climate in a particular region over time. Some areas, such as South Africa, have highly variable climates, with frequent droughts and floods being experienced as part of the natural climate cycle.

Climate change, on the other hand, refers to long-term changes in the climate experienced in a particular region. While climate change occurs naturally over long periods of time, in the context of this document, climate change refers to the rapid climate change currently being experienced as a result of human activities and the increased production of greenhouse gases.

10.1.2 Alignment with DEA

The Department of Environment Affairs (DEA) is designated to lead the country's climate change agenda with responding and adapting to climate change as one of several strategic national objectives. The recently released White Paper on National Climate Change (2011) provides the framework for South Africa's response to climate change and requires the development of sector strategies. One of the intended outcomes is to develop the skills base required to deal with the consequences of climate change. The DEA is currently developing Long Term Adaptation Scenarios (LTAS) for South Africa, which will also be useful in assisting other sectors to develop their adaptation strategies. Improving the capability of developing countries to adapt to climate change was one of the key outcomes of the COP 17 held in Durban in 2011.

Managing in uncertainty

The uncertainty in projected water-related climate change impacts is one of the biggest challenges facing water managers. These managers must understand how this uncertainty influences the management decisions to be made and that decisions must be appropriate to a possible range of scenarios. A critical tool in this regard is adaptive management, in which water resource systems are carefully monitored and management actions are tailored and revised in relation to the measured changes on the ground.

It is against this background that the DWA is developing a Climate Change Response Strategy for Water Resources in South Africa. This strategy will provide guidance on adaptation to the water-related impacts of climate change and to maximise any beneficial impacts. The strategy will include the approach to be taken to climate and water adaptation, as well as measures and actions, where possible, focusing on actions that support both adaptation and mitigation.

10.1.3 Climate change and models to calculate impact

The impacts of climate change are calculated through the use of scientific models called Global Circulation Models (GCM). There are a number of such models, and each is based on slightly different assumptions or rules. Because of the number of different factors affecting the global climate, it is very difficult to create a model that can exactly replicate the real world. As a result, the models all give different results in terms of what the climate change impacts will be and over what period. Some of the models give extremely different results for particular areas, with some, for example, predicting increased rainfall and others predicting decreased rainfall in particular areas. While some models reflect a trend of wetting in the eastern parts and some drying in the west of the country, some models reflect a strong drying trend across the country. This shows the uncertainty of South Africa's possible climate futures and means that the water and climate strategy must consider the possibilities of a very challenging climate scenario.

As a result, one cannot predict climate change impacts with any certainty, and the recognition of this uncertainty must be built into all climate change response strategies.

Changed rainfall results in amplified hydrological impacts. Thus, a reduction of 10% in rainfall results in a much greater reduction in water availability.

There is much greater agreement between the various GCMs about temperature increase. Surface air temperature in South Africa is expected to warm everywhere, but most strongly in the interior (as indicated in **Figure 16**). In the intermediate future, annual temperature will increase by 1.5 to 2.5°C along the coastline and by 3.0 to 3.5°C in the far interior. Temperature change will accelerate towards the end of the century with increases of 3.0 to 5.0°C along the coast and more than 6.0 °C in the interior. This increase in temperature is likely to result in increased water demands and increased evapotranspiration.

To assess the water-related impacts of climate change in the Climate Change Response Strategy, the country has been divided into six hydro-climatic zones, as represented in **Figure 17**. A high level assessment of the possible climate change impacts in each of these zones has been examined and is contained in the Climate Change Response Strategy for Water Resources in South Africa.

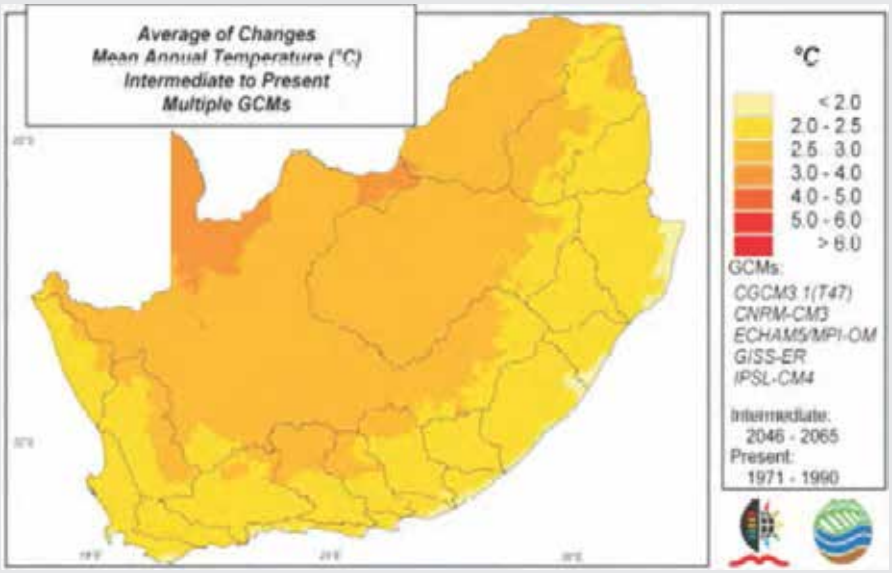


Figure 16: Downscaled seasonal temperature increase for January (Schulze, 2011)

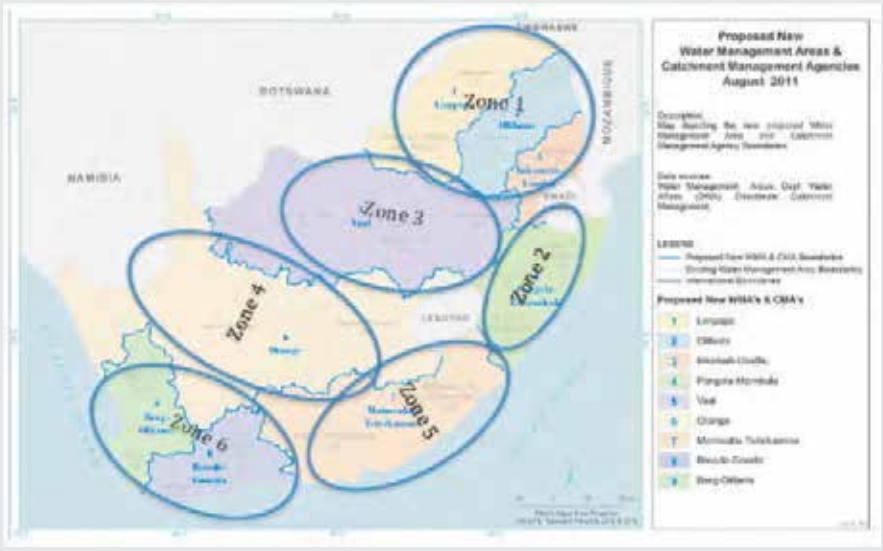


Figure 17: Six hydro-climatic zones

Arising from the assessment of the water and climate scenarios for South Africa, several key issues need to be addressed, as follows:

- There is a need to build the capacity of water sector institutions to function in a context of high levels of uncertainty.
- There is a need to build the water sector's climate response capability and commitment to timeous action, to be able to avoid inappropriate responses, and to ensure that the sector is able to manage water in a context of high levels of uncertainty.
- Improved collaboration between all agencies to address climate change, in particular those that are likely to have overlapping and or similar objectives.
- There is a need to adjust the water resources planning and management processes in the country to build the required resilience and adaptive capacity in society and ecosystems. A key element of this is improved water conservation and water demand management across the country.
- There is an urgent need to strengthen the present rainfall, environmental, hydrological and hydro-geological monitoring systems to support effective climate change detection and effective adaptation.
- The available human capacity relating to climate change impact assessments and adaptation within the water sector is very limited and needs to be strengthened.
- There is a need to address research gaps in current water sector climate change programmes and water and climate change knowledge.

10.2 Principles

- A sound scientific foundation is the basis of all recommendations and actions.
- A balanced approach between preparedness and over reaction must be maintained.
- There is integration of potential climate change impacts into water resources and water services planning and supply at all levels.
- Leadership is provided by the DWA with strategic partners to drive appropriate strategic responses to minimise the impacts of climate change.
- Existing initiatives and institutions are aligned to improve the effectiveness of the national response.
- Climate and water is elevated onto appropriate agendas to ensure that this relatively new field is incorporated into the national agenda and managed adequately.
- Knowledge of the climate-water relationship and how this will impact on society is improved.
- Critical natural infrastructure (ecosystems) are protected and enhanced.
- Physical infrastructure is planned for a changing future using a no-regrets/low regrets approach.

No-regret measures are ones that will prove worthwhile doing even if no (further) climate change occurs or if the climate change impacts are different from those expected.

Low-regret measures are ones that will only require small additional expenditures to cater for the negative effects of climate change.

10.3 Objectives

The key objectives of a climate change strategy for the water sector include:

- Reduce the vulnerability and enhance the resilience of communities, people, enterprises and ecosystems, to water-related impacts of climate change, particularly for those groups most at risk.
- Improve and enhance water resources management processes to build the required resilience and adaptive capacity.
- Integrate climate change considerations into short-, medium- and long-term water planning processes for water resources and water services.
- Implement the best catchment and water management practices to maximise the degree of water security and resource protection under changing climatic conditions.
- Enhance the human, legal, regulatory, institutional, governance and financial resources and capacity to assist with the effects of climate change on water.
- Undertake focused monitoring and research to ensure the efficacy of water adaptation approaches over the long term.
- Ensure inter-linked climate and hydrological modelling tools that represent the complex inter-related natural systems.

10.4 Strategic actions

Many of the strategic actions outlined below are parallel to, and build on strategic actions in several other chapters in this Strategy. They are highlighted here in relation to their specific importance for responding to climate change.

10.4.1 Water governance

10.4.1.1 Adaptive approach

In implementing the adaptation strategy, the approach will combine the traditional approach of down-scaling the GCMs with a bottom-up approach based on monitoring and assessment of actual trends. In this way, defendable climate-water scenarios that show clear signals will be developed and updated to enable robust decision making.

Responses to climate change will be addressed via existing programmes, and investment will be made in skills development and resource allocation for dealing with the long-term effects of climate change.

10.4.1.2 Building adaptive institutions

The DWA will work to ensure that the institutions responsible for water management and governance are able to adapt timeously and effectively to changing climatic conditions. This requires that management institutions such as municipalities, water boards, CMAs, international bodies and the DWA are designed and operate as adaptive, learning institutions.

10.4.1.3 Intergovernmental relations and collaboration

To manage water-related adaptation and mitigation effectively, the DWA will put in place the necessary co-operation and co-ordination mechanisms in the water sector and between vulnerable sectors.

Activities such as research, water planning, infrastructure investment, and risk and disaster management will be better coordinated, robust and focused, under the leadership of the DWA.

10.4.1.4 Awareness and communication

The DWA, with the WRC and other water institutions, will run awareness and communication campaigns to ensure that all water institutions and water users understand the water-related climate change issues and how to respond to them. The DWA will also seek to consult widely with stakeholders on appropriate climate change response strategies.

10.4.1.5 Building resilience and reducing vulnerability

The poor, particularly the rural poor, are the most vulnerable to climate change. Therefore, there is a particular imperative on water institutions to ensure the protection of the poor in relation to water, both through management systems and through appropriate infrastructure choices. It is also important to recognise, however, that poor communities have complex coping strategies to cope with climate variability, and it is important to understand and build on these coping strategies as a way of building resilience and reducing vulnerability.

10.4.1.6 Research and development

Research into existing gaps in scientific understanding such as impact studies on land-use, sedimentation, groundwater, water quality, dam safety, flooding, infrastructure sustainability, and evaporation, the socio-economic costs, and new elements of the process such as stilling and its effect on evaporation will be initiated.

Impact studies will be conducted for all catchments, and the relative importance of climate change on water resources versus other stressors will be assessed.

The Water Research Commission will continue its current research into the potential impacts of climate change on water. This should include looking at water quality issues as well as research into the social elements of adapting to climate change.

Further research will be supported to increase the accuracy of possible future climate change predictions by improving their scientific basis and initiating additional research into climate and water models to develop more robust and dependable results.

10.4.1.7 Regional engagement

The DWA will work with the National Planning Commission in developing shared water solutions as part of the SADC economic integration process.

10.4.1.8 Climate financing

The DWA will ensure that climate change resilience for water infrastructure is factored into the National Water Investment Framework.

10.4.2 Infrastructure development, operation and maintenance

10.4.2.1 Increasing water supply

The DWA will use the no-regrets/low regrets approach to making decisions on future infrastructure development and will communicate this approach to all water sector institutions. The DWA will consider all appropriate sources of water for increasing water supply, including groundwater and alternative water supply sources. The use of these will be tested against the climate change scenarios.

10.4.2.2 Water supply and sanitation

Water Services Authorities must develop climate response strategies in the WSDPs, implement water conservation and water demand management and reduce levels of non-revenue water.

10.4.2.3 Flood protection measures

The DWA will put in place improved flood early warning systems in critical catchments and will work with municipalities to improve their flood early warning systems.

10.4.2.4 Infrastructure safety

Increased rainfall intensity in certain areas may result in increased flood pressures on dams and other infrastructure with concerns regarding the safety and resilience of such infrastructure. This includes urban infrastructure such as treatment works and wastewater treatment works as well as industrial infrastructure such as tailings dams. All water institutions managing infrastructure must address the issue of climate change impacts in their asset management plans.

10.4.2.5 Hydro-geo-meteorological monitoring systems

With the uncertainties arising from the downscaling of the GCMs, monitoring is critical to being able to assess actual water-related climate change impacts and trends on the ground. Therefore, the monitoring and evaluation of water and climate data must be prioritised under the coordination and leadership of the DWA and the adequacy of the weather, environmental, hydrological and hydro-geological monitoring systems must be substantially improved, Equally, standardised reporting protocols must be agreed on and implemented under the leadership of the DWA and DEA.

10.4.3 Water management

10.4.3.1 Scenarios, climate modelling and water availability

The DWA will work with the WRC and relevant experts to improve climate change modelling for South Africa, with a particular focus on understanding the hydrological impacts. Arising from this, the DWA will determine the availability of water under conditions of climate change.

10.4.3.2 Vulnerability assessment

The DWA will conduct a vulnerability assessment for the country to assess the most critical areas for the implementation of water and climate change adaptation measures.

10.4.3.3 Planning and strategies

The DWA will finalise the Climate Change Response Strategy for Water Resources in South Africa. This document will form the framework for all of the other strategic actions listed here, and will serve as the guideline for climate change response in the water sector in particular. Following from the Climate Change Response Strategy for Water Resources in South Africa, all catchment management strategies, Reconciliation Strategies and investment planning must address the issue of climate change adaptation and mitigation.

Responses to the water-related impacts of climate change must be addressed in the programmes and strategies of all water sector and water dependent entities, and must be addressed by all spheres of government to ensure resilience in their own areas.

Water-related climate change adaptation and mitigation planning should be incorporated into all water services development plans and IDPs.

In looking at strategies to address climate change in the water sector, the full range of adaptation options, including protecting and developing natural capital or taking an ecosystems-based approach should be assessed.

Equally, all initiatives should have an increased focus on integrated scenario planning and flexible adaptation plans, which are key to managing uncertainty.

10.4.3.4 Water allocation and authorisation

The tools for allocation of water will need to be able to adapt to intra- and inter-annual changes in water availability. The current tools available to the DWA are adaptive in nature, but the mechanisms for applying them will need to be refined.

10.4.3.5 Water conservation and water demand management

The implementation of water conservation and water demand management is a critical element of adapting to climate change. This must be implemented by all water sector institutions and water users, and should include the optimisation of dam and groundwater operation, as well as the reduction of physical water losses and the introduction of water-efficient appliances, processes and crops.

10.4.3.6 Water quality management

Climate change will affect water quality but in many areas the impacts may be masked by changes in land use, or compliance to effluent standards. Some of the impacts can be foreseen and mitigated by careful planning to include potential climate change in water quality management strategies.

10.4.3.7 Resource management and protection

Aquatic ecosystems will change substantially over time as a result of climate change. These changes will need to be factored into reserve determination processes, and the protection of aquatic ecosystems. This will be supported by increased research in this area.

10.4.3.8 Disaster management

The potential impacts of water-related climate change will be integrated into disaster management systems and processes and the ability to respond to unforeseen events through, for example, early warning systems and effective planning for incidences of flooding and drought will be enhanced.

CHAPTER 11
INTERNATIONAL COOPERATION AND TRANS-BOUNDARY WATER COURSE MANAGEMENT

11.1 Context and current challenges

This chapter on international cooperation and trans-boundary water course management outlines how South Africa should ensure that Integrated Water Resources Management (IWRM) is implemented in a manner that conforms to international water protocols and treaties while being compliant with the legislation governing water resource management in SA.

Approximately 60% of the streamflow in rivers in or on the borders of South Africa water is shared through trans-boundary water systems. As a water-scarce country, this is a significant amount of shared resources that has to be managed with care. The National Water Act refers, in Chapter 10 specifically, to International Water Management and it provides for the establishment of institutions to implement international agreements for the management and development of water resources.

As we live in a global village where all activities are interconnected, resources transcend borders and the work force migrates with ease, it is important for the DWA to also interact on the global arena. Amongst others, threats to water quality, fresh water security, ecosystems and water governance are challenges faced not only by the South African water sector, but all over the Region, Africa and the globe.

Guided by South Africa's Foreign Policy, it is important for the DWA to engage with international partners bilaterally and through multilateral fora. Through international engagements the South African water sector shares valuable lessons and learns from international best practices to improve service delivery and aspects of the whole water value chain. In essence, International Water Cooperation assists water resources management to ensure the sustainable use of water to the benefit of all South Africans.

Global governance and management in the water sector dictates that nations cooperate in order to share and exchange knowledge, and develop protocols and treaties to address a variety of issues such as water quality, water use efficiency, water infrastructure development, water security and protection of ecosystems. Cooperation at multilateral fora is also beneficial for the collective mobilisation of resources to face looming water challenges, threats and risks in any other region in the world.

11.1.1 Trans-boundary river basins

Since most of the region's water resources occur in the 15 trans-boundary river basins, sustainable water resource management requires the cooperation of all the riparian states. In light of this, the Southern African Development Community (SADC) adopted the Revised Protocol on Shared Water Courses in the Southern African Development Community (SADC Protocol), which established the preconditions for joint management of trans-boundary water resources. In addition, the SADC focuses on developing trans-boundary water infrastructure for improving the lives of the people living in the region.

South Africa is a signatory to the SADC Revised Protocol on Shared Water Courses; it thus has an obligation to fulfil its commitments through cooperation with its neighbours in the management of international waters in the interest of regional economic integration, peace and security. South Africa shares four major rivers systems with six neighbouring countries:

- Orange/Senqu system shared with Lesotho, Botswana and Namibia
- Limpopo system shared with Botswana, Zimbabwe and Mozambique
- Inkomati system shared with Swaziland and Mozambique
- Usuthu/Pongola – Maputo system shared with Mozambique and Swaziland

The primary purpose of the SADC Protocol is to develop closer cooperation between SADC member states for the sustainable and coordinated management, protection and utilisation of shared watercourses in the most beneficial way to advance the SADC Agenda of regional integration and poverty reduction.

This overall objective can only be achieved through the establishment of shared watercourse institutions or River Basin Organisations (RBO). Shared watercourse institutions can be established as a River Basin Commission, Joint Water Commission, Technical Committee or Joint Water Authority. However, the establishment of a shared watercourse institution is guided by a series of general principles of customary law.

The most prominent are:

- **Equitable and reasonable utilisation:** shared watercourse shall be used and developed by watercourse states with a view to attain optimal and sustainable utilisation.
- **Prevention of significant harm:** shared watercourse states shall, in utilising a shared watercourse in their territories, take all appropriate measures to prevent causing significant harm to other watercourse states, and take all necessary measures to eliminate or mitigate such harm as may occur.
- **Prior notification:** before a shared watercourse state implements a planned measure that may have an adverse effect upon other watercourse states, it shall provide those states with timely notification.

Figure 18: International river systems shared by South Africa

11.1.2 Bilaterals (Africa and globally)

South Africa has entered into a number of diplomatic relationships with African and other countries around the globe and has signed partnership framework agreements that have paved the way for different South African sectors to enter into cooperation or bilateral agreements with these countries. These cooperation agreements, also known as Memoranda of Understanding (MoU), define how government institutions in the two countries will conduct their cooperation in the identified areas. The participating institutions are guided by the State Law Advisors to ensure legal compliance and the MoUs are signed by Ministers of both countries.

South Africa also acknowledges that it does not have all the necessary tools to confront water challenges facing its citizens, and that there are other developing and developed countries who have gained considerable experience in water resources management.

Bilateral relations are developed in the spirit of mutual interest in advancing the water sectors of both countries, most often through the exchange of skills, expertise and knowledge. Technologies, governance models, management tools and other information are also shared to improve the way in which water resources are managed. Joint pilot projects are means to illustrate and test the relevance and appropriateness of alternative water management solutions within the South African context.

South Africa is a leader in several water-related fields and local expertise, technologies and skills are sought-after in the global arena. Lessons are shared through interactive workshops, joint research projects and by other means. Partnerships are formalised to ensure a streamlined focussed approach and to enable reporting in line with national prescripts. Committees are formed to guide the implementation of each partnership agreement.

11.1.3 Multilaterals

After 1994, South Africa became eligible to join international organisations and one important milestone was to become a member of the United Nations (UN). One of the purposes for the existence of the UN is to achieve international co-operation in solving international problems of an economic, social, cultural or humanitarian character. The UN also promotes and encourages respect for human rights and fundamental freedoms for all without distinction of race, sex, language or religion.

In striving towards fulfilling the above-mentioned purpose, the UN has established a number of subsidiary organs to focus on this wide range of issues, and water is among those.

The DWA participates actively in a number of programmes that are run by the UN and its agencies. These include the United Nations Environment Programme (UNEP), particularly UNEP GEMS, United Nations Conference on Sustainable Development (UNCSD), United Nations Framework Convention on Climate Change (UNFCCC), and a number of United Nations Educational, Scientific and Cultural Organisation (UNESCO) programmes, which include FETWater, IHP and IHE programmes.

The eight Millennium Development Goals (MDG) form a blueprint agreed to by all the world's countries and all the world's leading developmental institutions. The MDGs have galvanised unprecedented effort to meet the needs of the world's poorest people.

The UN MDG 7, target C, envisages halving the proportion of the population without sustainable access to safe drinking water and to basic sanitation by 2015. It is specifically for this reason that South Africa undertook to contribute positively to the successful achievement of the MDGs and the water sector is an important participant in this programme for the government. The South African water sector has been mobilised under the government's leadership to play a meaningful role towards attainment of the MDGs. This has led to South Africa being one of the few countries that have actually met their MDG targets for water and sanitation.

The world has become a global village in the sense that multilateral and trilateral initiatives have become the dominant route to solve most of the world's leading challenges. South Africa actively participates in these initiatives with a view to:

- Influence the global water agenda
- Share with the world unique initiatives and to learn from one another
- Enrich the international debate
- Contribute in discussions leading towards resolution of water management challenges facing developing economies

South Africa's cooperation with multilateral blocs has grown to include the European Union (EU), India, Brazil, South Africa (IBSA), BRICS, World Water Council (WWC), Organisation for Economic Cooperation and Development (OECD), International Water Association (IWA) and the G8, among others. South Africa's role in multilateral forums in Africa has a significant influence on global decisions and there is a strong linkage between these forums.

These multilateral institutions provide a platform for countries to share and exchange knowledge and expertise on a wide range of water-related issues and challenges. These issues range from financing of the water sector, capacity building, infrastructure development, climate change, groundwater management, desalination, water reuse, and technological research and development, which responds to the objectives for South Africa's participation

The World Water Forum arranged by the World Water Council (WWC) and the Stockholm World Water Week arranged by the Stockholm International Water Institute (SIWI) are international multi-stakeholder institutions established to provide platforms for:

- Showcasing water-related technologies
- Participating in debates
- Exchanging and sharing experience

These institutions aim to reach a common strategic vision among all stakeholders in the global water community on water resources and water services management.

Southern African Development Community (SADC)

The Regional Indicative Strategic Development Plan (RISDP) is a comprehensive development and implementation framework guiding the Regional Integration agenda of SADC over 15 years (2005-2020). It is designed to provide clear strategic direction with respect to SADC programmes, projects and activities in line with the SADC Common Agenda and strategic priorities, as enshrined in the SADC Treaty of 1992. The RISDP is complemented by the following policy frameworks:

- Regional Strategic Action Plan III (RSAPIII)
- Climate change and adaptation strategy
- Regional Infrastructure Development Master Plan (RIDMP)

These SADC legislative frameworks are all aimed, at addressing the following issues, among others:

- Protection of water resources
- Infrastructure development and management
- Disaster management
- Groundwater development and management
- Climate change
- Water resources systems operations
- Water reuse
- Water finance and funding
- Water sector capacity building
- Research and development

Furthermore, the SADC Regional Water Policy and the SADC Regional Water Strategy is strongly aligned with South African water policies and strategies. The DWA, therefore, can continue to play a significant role in assisting the SADC Secretariat and the SADC countries to implement and align themselves to the SADC policies and strategies.

South Africa serves on the SADC Water Resources Technical Committee (WRTC), which develops and adopts implementation strategies relating to the above water resources management issues and challenges in the region.

African Ministers' Council on Water (AMCOW)
The Sharm El Sheikh Declaration, which gave impetus to the AMCOW programmes, was a call by African Heads of State for a commitment to be made to:

- the development and updating of national water management policies, regulatory frameworks and programmes for action; and
- the preparation of national strategies and action plans for achieving the Millennium Development Goals (MDGs) in respect of water supplies and sanitation.

South Africa serves in the AMCOW Executive Committee (EXCO) and in its Technical Advisory Committee (TAC). Like the SADC, AMCOW provides policy development leadership on water issues and challenges at a continental level.

11.1.4 Official development assistance

Official Development Assistance (ODA) is defined as the flow of official governmental financing for the promotion of the economic and social development of developing countries. Many trans-boundary basin organisations in developing countries receive significant support in the form of grants and loans from ODA. To ensure that development assistance is used optimally, that adequate reporting on disbursements takes place and that the funds are properly allocated, development partners are guided by the Paris Declaration on Aid Effectiveness and the Accra Agenda for Action. South Africa is currently an ODA recipient country, a signatory to the Paris declaration and participates in trilateral partnerships where development assistance is spread between two recipient countries.

ODA can also be in the form of in-kind contributions of activities or resources; for example, secondment of experts to an organisation or the provision of equipment. ODA received in South Africa is guided by National Treasury guidelines and processes.

International Water Cooperation serves as an enabler for the DWA to improve its expertise and processes, for identifying opportunities, forging beneficial relationships and reporting on international engagements and obligations. This makes significant contributions to the advancement of our national interest through effective and sustainable management of water resources.

11.2 Principles

The principles are primarily set out in the following:

- The Millennium Development Goals
- Principle 11 of the water law on international resources, particularly shared river systems
- The SADC Revised Protocol on Shared Water Courses in Southern Africa, to which South Africa is a signatory
- Presidential Outcome 11 on "creating a better South Africa and contributing to a better and safer world"
- Foreign policy discussion document from the Department of International Relations and Cooperation
- SADC Regional Strategic Implementation Plan of 2011 - 2015
- AMCOW Work plan
- Relevant South African legislation and policies governing international water cooperation

11.3 Objectives

- Advancement of the African agenda through sustainable development by multilateral and bilateral cooperation in Africa.
- Advancement of the water agenda in the global system of governance and water diplomacy in support of political and economic relations through multilateral cooperation.
- Advancement of strategic global bilateral relations, particularly South-South and North-South relations.
- Enhancing technical and development cooperation regarding international resources.

11.4 Strategic actions

11.4.1 Use strategic international partnerships to formulate responses to sector challenges and opportunities

- Utilise strategic partnerships to harness opportunities for capacity building and exchange of expertise and information in addressing challenges faced by the water sector, such as acid mine drainage, the impact of climate change on water resources, and water quality.
- Consistently identify international opportunities for job creation, research partnerships, provision of services in strategic partner countries and institutions and business opportunities for the benefit of South Africa's private sector, the water sector institutions and the citizens of South Africa.
- Enhance interaction with international civil society, non-government organisations and other key local strategic stakeholders on international water issues and the implementation of key strategic water engagements with the aim of creating dynamic partnerships for development and cooperation.
- Facilitate access to sources of funding, expertise and in-kind resources for national and regional development initiatives related to water.

11.4.2 Guide the water sector in international arrangements

- Provide guidance to the sector in international agreements, including servicing existing agreements and obligations, and enhancing future engagements in strategic partnerships at the bilateral and multilateral levels.
- Play a consistent role through influence for advancing common regional and continental interests, based on the national interest in the global governance system.

11.4.3 Promote lesson sharing and benchmarking

- Tap into the expertise available through international partnerships and use international relations as a benchmark for sharing lessons and experiences, exchanging expertise and further advancing the national interest by providing capacity building and expertise to partners who can be assisted by South Africa.
- Consistently identify trends and practices that can contribute to the refinement of South African policies, strategies and practices.

CHAPTER 12
FINANCIAL MANAGEMENT

12.1 Context and current challenges

12.1.1. Overview

The chapter on financial management is a key cornerstone of the NWRS2. Having the necessary financial resources in place, together with the necessary systems, structures and processes, will enable the implementation and progress monitoring of the NWRS2. Financial management must thus provide for the financial resource needs identified in the other chapters.

This chapter covers the full scope of Financial Management, within the framework of the total water value chain and all the sectors involved in and impacting on water resources management. The total sector perspective and value chain showing the interface between water resource management and the user sectors is illustrated in **Figure 19.**

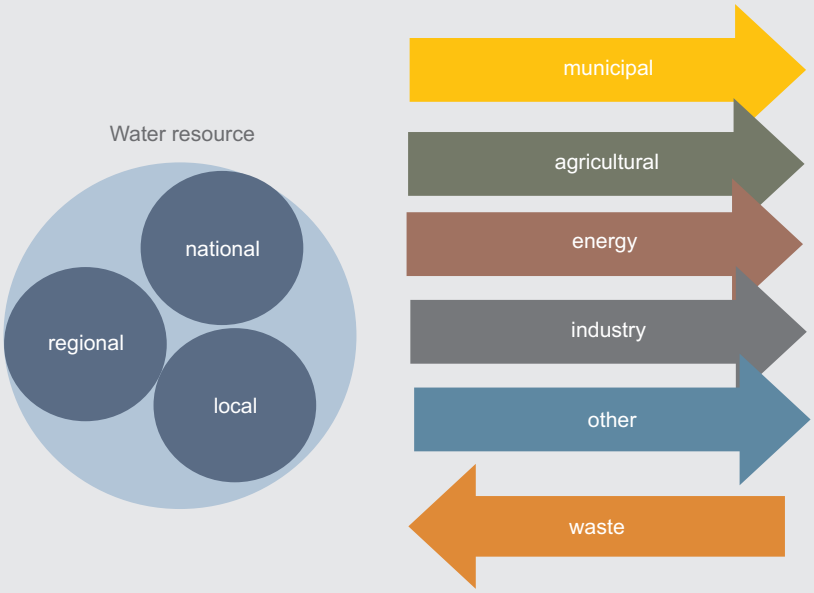


Figure 19: Total sector perspective and value chain

The figure shows the interdependence of the water use sectors on the resource. If the availability of the water resource were to be threatened because the national, regional or local water institutions lacked the necessary financial resources to plan, develop or operate and maintain water resource infrastructure, then all of the water use sectors would be directly impacted and would be unable to grow.

Likewise, the commitment, participation and accountability of the user sectors are critical to ensuring that the national, regional and local water institutions have the financial resources required to achieve the objectives set out in Section 12.3.

Financial management for the purpose of this NWRS2 considers and includes aspects of financing, sustainable functional management, investment, viability and affordability.

Financial risk

Without sufficient and properly managed financial resources:

- NWRS2 cannot be implemented
- Works will not be constructed, refurbished or properly operated
- Water institutions will not be financially sustainable
- No sustainable water resource management, meaning that the environment will not be protected, the social obligations will not be met and there will not be economic growth
- Water will not be available where required at the required level of assurance
- Every sector dependant on water, including domestic, agricultural, industrial and energy will be unable to grow

The financial challenge

Capital investment in new water infrastructure and in the refurbishment of existing infrastructure is projected to require an estimated R670 billion over the next 10 years. Based on industry norms, additional investment of approximately R30 billion will be required for sustainable water management programmes. In total, an amount of R700 billion will be required to be invested by the water sector over the next 10 years, or an equivalent of R70 billion per year.

Currently, only R30 billion per year is being accessed for water sector investment. This includes DWA MTEF allocations, as well as transfers to local government and private sector investments. To put the figures in perspective, the DWA's total budget allocation from the fiscus for 2013/14 is R10.2 billion.

While a portion of the required investment will be provided by the public sector, the private sector will have to contribute substantially. The public sector alone will not have sufficient funds to enable full value chain financial management in the sector.

Stretching financial resources
Given the state of the world economy, it is likely that funding will be constrained for some time and, accordingly, it will be necessary to stretch the financial resources by prioritising investments, optimising available financial resources, stretching the lifespan of infrastructure, funding appropriate solutions and improving the management of the funds.

Figure 20 shows that financial management is an integral component of the NWRS2.

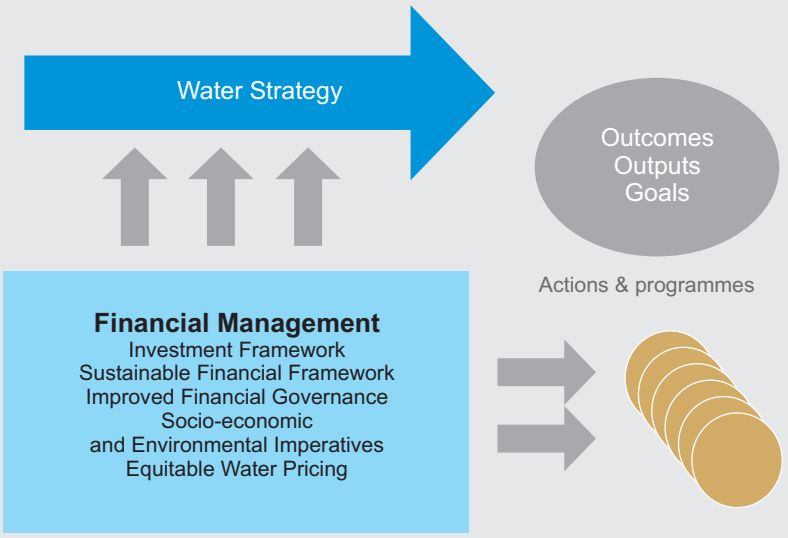


Figure 20: Positioning financial management in the NWRS2

As indicated in **Figure 20**, the NWRS2 determines the requirement for financial resources.

Financial management in turn determines the availability of the financial resource, and the availability of the financial resources determines the actions and programmes that can be funded, and the objectives that can be achieved.

The figure also shows that financial management comprises the following elements which are contextualised in this chapter:
- Investment framework
- Sustainable financial management and administration
- Improved financial governance
- Socio-economic and environmental imperatives
- Equitable water pricing
- Associated financial considerations

12.1.2 National Water Investment framework
To facilitate effective and timely investment, the DWA has initiated the development of a comprehensive investment framework that will inform budgeting and integrated planning based on a life-cycle approach, which includes planning and construction costs, operation and maintenance, financing costs and the costs of sustainable water management.

The National Water Investment Framework will include the programmed costs and financing of all aspects of sustainable water management programmes, such as:
- Planning, designing and developing water resources infrastructure
- Protecting the resource
- Allocation of water to support water based rural livelihoods and food security for all
- Establishing sustainable water institutions
- Building capacity and developing skills and installing proper governance
- Establishing information management systems
- Implementing water conservation and water demand management programmes
- Improving scheme and system operations
- Regulation of the sector

The National Water Investment Framework is integrated with the NWRS2. It is the mechanism by which investments required by the NWRS2 will be planned for and funded.

12.1.2.1 Positioning the investment framework in the sector
The investment framework will include the whole water sector value chain, from source to tap to waste and back to source. The investment requirements of the DWA, CMAs, water boards, and WSAs and WSPs will be included.

The investment framework will also include investments that benefit the municipal, agricultural, energy, industrial and other water-use sectors.

12.1.2.2 Financing model and funding mix
As part of the investment framework, a financing model is being developed that optimises the use of both on- and off-budget funding to source sufficient funds to meet the required investment targets.

Water resources infrastructure will usually be funded by a combination of government and private sector funding because water resource development and bulk infrastructure will always be targeted at a mix of both social and economic uses as discussed in the chapter on water resource planning, development and management.

The funding mix will be such that government transfers and grants will be used to finance the portion of the infrastructure investment required for supplying water to meet social development objectives, such as that portion used to supply new resource-poor farmers or to provide the basic level of water services for domestic use.

Government transfers and grants will also be used to establish the catchment management agencies and the national water resources infrastructure entity and to fund some of their start-up activities.

12.1.2.3 Private sector participation

The private sector will be mobilised to finance the economically viable portion of water resource development; that is water supplies to users who can afford to repay loan finance, such as industries, mines and power generation and domestic users receiving high levels of water services.

The private sector will be encouraged to contribute towards the social component of infrastructure investment where they use water from the same infrastructure. For example, mines will be encouraged to invest a portion of their corporate social investment obligation (CSI) in water infrastructure for the benefit of communities from which they draw their labour force.

To date, private sector funding of water resource development has mainly been channelled through TCTA in the form of loans or bonds. Water boards also borrow funds from the private sector within their prescribed borrowing authorities. In addition, PPPs have recently mobilised capital contributions from mines and other large users.

Irrespective of the funding model adopted, the ownership of water resource infrastructure will always reside in an organ of state, whether the DWA, a regional water utility, a municipality, a CMA or a Water User Association.

12.1.3 Sustainable financial management and administration

12.1.3.1 Revenue and debt management

Ineffective financial management and poor cost recovery is impacting negatively on the financial viability of water infrastructure and water management and water services institutions. The DWA Water Trading Entity is, at present, not recovering all of its costs from water users so it is not breaking even.

Similarly, municipalities are not recovering all of their costs from their customers, and water boards are thus not recovering all of their costs from these municipalities.

The DWA will mobilise the sector to address revenue management and debt collection problems. The DWA will also establish a debt management desk to support the DWA Water Trading Entity, municipalities and water boards with debt recovery.

The DWA has also initiated a programme to address the following financial management issues within the Water Trading Entity:

- Incomplete and inaccurate database of registered and licensed water users
- Inaccurate water meters and absence of meters
- Inaccurate and out-of-date billing information
- Inadequate debtor management leading to non-enforcement of obligations to pay

12.1.3.2 Capacity and skills development

Financial management depends on properly qualified and skilled financial managers. These skills are not available in abundance.

Capacity building and skills development are discussed in **Chapter 15.**

Regulation

The DWA has commenced with the establishment of a regulation function with a view to regulating water prices from source to tap as well as water institutions. The regulation role of the DWA and the various water management institutions is discussed in detail in the chapter on regulation of the water sector.

12.1.4 Improved financial governance

Currently, the sector suffers an unacceptably high level of financial losses, mainly for reasons that could be addressed through proper governance and management. The financial losses are evidenced by:

- Unacceptably high water leakages
- Failure to meter water supplied and other forms of unaccounted for water
- Poor infrastructure planning and poor investments
- Poor operation and maintenance
- Pollution of the resource leading to unnecessarily high water treatment costs
- Corruption, tender fraud, maladministration and lack of governance
- Failure of local government to ring-fence the water sector finances and the diversion of funds allocated to water to non-essential purposes
- Inefficient institutional performance
- Poor revenue and debt management
- Inefficient water pricing that results in the under-recovery of costs
- A misunderstanding of the free basic water policy and the neglect to manage the quantity of water supplied in terms of the policy and the poor maintenance of indigent registers

The failure to properly govern the available financial resources is not sustainable and the consequences are more serious, given the budget deficit.

The DWA will lead the sector in dealing decisively with inadequate governance, fraud and corruption. Governance strategies are provided in more detail in the chapter on institutional arrangements.

12.1.5 Socio-economic and environmental imperatives

Core themes of the NWRS2 are the protection of the resource and social equity, especially in water allocation and affordability of access.

The environment cannot pay for the water it uses.

Consequently, water is allocated to the environment as a priority and for free by way of the environmental Reserve. The environmental Reserve and the protection of the environment is discussed in detail in **Chapter 5** on Water resource protection.

However, the environment does not only require a sufficient quantity of water, it also requires protection against the discharge of poor-quality water. The waste discharge charge system is discussed in the water pricing section below.

Similarly, the poor and indigent cannot afford to pay for the full cost of the water they use. To promote social equity, it is a critically important requirement that retail tariffs are pro-poor and that the very poorest are able to access a basic water service for free. The norms and standards in respect of tariffs for water services discussed under-pricing in the next section guarantee this requirement. The very poor are often dependent on their crops for food security. Financial support to water-based rural livelihoods is also discussed in the pricing section.

12.1.6 Equitable water pricing

12.1.6.1 Pricing Strategy for Water Use Charges

The National Water Act makes provision for a Pricing Strategy for Water Use Charges (Pricing Strategy) to promote financial sustainability and economic efficiency in water use. The Act also makes provision for financial assistance to water users in the form of grants, loans or subsidies.

A Pricing Strategy that includes charges for abstracting and storing water and for stream-flow-reduction activities was first published in Government Notice No. 1353 of 12 November 1999. A revised Pricing Strategy for raw-water-use charges was published in 2007. However, the following issues still require attention and refinement of the Strategy:

- The water resource management charge does not reflect the full management cost because of the capping of the charge for certain sectors.
- The infrastructure charge does not provide sufficient funding for covering the life cycle costs of infrastructure maintenance and refurbishment because of the capping of charge increases for the irrigation sector.
- The price of water does not send the correct economic signal that water is a scarce resource.
- The price of water varies considerably from place to place, sometimes to the detriment of low income areas.
- The price of water is not always charged based on the actual volume of water consumed.

To address these issues, the DWA has initiated a revision of the Pricing Strategy. The revised Pricing Strategy will be driven by ensuring that the full costs of water resources infrastructure and management are covered in the charges, with targeted subsidies replacing the current broad brush caps that are in place. The intention is to move towards linking charges directly to actual cost, with subsidies provided where necessary.

The Pricing Strategy for Water Use Charges, although published separately, will form part of the NWRS2 when it is finalised.

12.1.6.2 Waste discharge charge system

The waste discharge charge system (WDCS) is based on the polluter-pays principle and aims to promote the sustainable development and efficient use of water resources, internalise the environmental costs of using water and create financial incentives for water users to reduce waste and use water resources more optimally and recover costs associated with mitigating resource quality impacts of waste discharge.

The WDCS comprises two distinct charges: a Waste Discharge Levy and a Waste Mitigation Charge. The Waste Mitigation Charge is intended to cover the quantifiable administrative costs of implementing measures to mitigate the negative impacts of waste related discharges. The NWA provides for levying such a charge.

The Waste Discharge Levy will be a disincentive or deterrent to the discharge of wastewater and will be based on rate of water utilisation as a means of disposing of waste. It will be necessary to introduce legislation in Parliament in the form of a Money Bill in order to enable the DWA to raise this levy.

The DWA is piloting the system in three priority catchments. The intention is to progressively implement the WDCS across a range of impacted and threatened catchments.

12.1.6.3 Norms and standards for tariffs

Section 10 of the Water Services Act 108 of 1997 provides that the Minister may, with the concurrence of the Minister of Finance, from time to time prescribe norms and standards in respect of tariffs for water services.

The Minister gazetted norms and standards in GN R652 in GG 22472 of 20 July 2001 in respect of water supply tariffs charged by water services authorities (WSAs).

The norms and standards provide for pro-poor municipal water tariffs in the form of block tariffs with a first tariff block or lowest volume tariff block with a maximum consumption volume of six kilolitres and which is set at the lowest amount, including a zero amount.

No norms and standards have been set for sanitation tariffs or for tariffs applicable to bulk potable water supplied by water boards.

The DWA has commenced with the development of comprehensive norms and standards with a view to regulating the water tariffs set by water services authorities and water boards, for water supply services and for sanitation services.

Financial support to water based rural livelihoods and food security for all

The Minister has gazetted regulations to provide for the granting of financial assistance to resource-poor farmers in support of agricultural water use development (Government Notice R.1036 in Gazette No. 30427 of 31 October 2007).

The regulations provide for historically disadvantaged farmers to be eligible for financial assistance, and for the procedure for applying for financial assistance.

The DWA is currently seeking to review the above regulations to expand the scope to include other water-based rural livelihoods and food-security initiatives.

12.1.7 Associated financial issues

12.1.7.1 Stretching financial resources

The constrained financial environment requires that the sector works smarter with the available resources. Financial resources will need to be stretched to achieve more with the limited available budgets.

12.1.7.2 Water conservation and water demand management

The costs of physical water loss, the capital requirements for new water resources infrastructure, and the constraints of poor water availability on water dependent economic growth means that WCWDM is a critical management priority for stretching the financial resources of the sector. Water conservation and water demand management is almost always a more cost-effective solution than the implementation of new infrastructure, and no new infrastructure should be developed until unauthorised water has been reduced to manageable volumes.

Water conservation and demand management are dealt with in detail in the water conservation and water demand management chapter **(Chapter 7)**.

12.1.7.3 Appropriate solutions and life-cycle costing

Another way of stretching the budget is to adopt appropriate technology solutions.

Techniques such as value engineering should also be adopted to ensure that investments in infrastructure and other solutions are cost effective over the full life-cycle and designed to be fit for purpose.

12.2 Principles

The principles of financial management in the water sector are:

- **Enabling equitable economic development:** Support new economic development in identified nodes, within the national aims of enabling equitable economic development, job creation and sustainable economic growth.
- **Social equity:** Contribute to social equity and redress of the imbalances of the past, both with respect to equitable access to water supply services and direct access to raw water.
- **Ecological sustainability:** The water needs for the effective functioning of aquatic ecosystems must be protected. The management activities required to ensure the provision of sufficient water for the ecological reserve must be paid for by all registered and billable users. To promote the preservation of resource quality, the polluter pays principle is adopted.
- **Financial sustainability:** Adequate revenue must be generated to fund the annual cost related to:
  - Management of the country's water resources
  - Operations, maintenance, refurbishment and betterment of existing Government water schemes and waterworks owned by water management institutions
  - Development of new user-funded schemes
- **Investments are planned:** All investment requirements, including infrastructure and sustainability requirements, are properly planned from source to tap and back to source.
- **Appropriate technology solutions and value engineering:** Investments in infrastructure must be cost effective and designed to be fit for purpose.
- **Public and private funding:** Both the public and private sectors must contribute towards the funding and financing requirements through appropriate mechanisms with ownership of water resource infrastructure residing with an organ of state.
- **Transfers and grants:** Transfers and grants must be targeted to benefit the poor and support inclusive economic growth.
- **Lifecycle funding:** Adequate funding must be available for the full lifecycle cost of the investment and must include for operations and regular refurbishment.
- **Stretching the financial resources:** The sector must work smarter with the available financial resources through proper financial governance, leaner institutions, appropriate technology and through techniques such as value engineering.

12.3 Objectives

Investment National Water Investment Framework

- A financially sustainable water sector in which water institutions are able to collect revenue and raise the funds required to support the planning and development of water infrastructure, asset management and water management activities and programmes including the protection of water resources, the allocation of the resource, and water conservation and water demand management.
- Investments made in terms of a robust financial framework and funding plan that are cost effective and fit for purpose (value engineered).

Sustainable financial management
Outstanding debt and other financial losses reduced to acceptable levels.

Improved financial governance and regulation
- Continually improving financial governance.
- The regulation of financial management, water use charges and prices from source to tap to protect water users and consumers, ensure the viability of water sector institutions and to protect the resource.

Equitable water pricing
- Raw water use charges, implemented in a way that provides appropriate signals with respect to the cost and value of water, that raise the revenues required to ensure financial sustainability, that allocate subsidies effectively and that ensure affordability for poor water users.
- Waste discharge charges implemented in a way that deters pollution and that incentivises the treatment and re-use of wastewater.
- Water services tariffs that are pro-poor, that provide appropriate signals with respect to the need to conserve water, and that support the sustainability of water services institutions.
- Financial support to water-based rural livelihoods and food security for all.

12.4 Strategic actions

12.4.1 National Water Investment Framework

National Water Investment Framework: The water sector, led by the DWA in partnership with relevant sector stakeholders, both public and private, will develop, finalise and maintain the investment framework. The water sector investment framework will incorporate the costs of the total sector value chain, infrastructure development and sustainable water management, including:
- water resource protection
- water reallocation
- financial support to water-based rural livelihoods and food security for all
- development of appropriate water and sanitation infrastructure
- re-use and other alternative sources of water (including mine-water drainage and desalination of sea and inland water)
- water conservation and water demand management
- refurbishment and upgrading of wastewater treatment plants to prevent pollution of water resources
- reducing the backlog in the maintenance of water infrastructure
- institutional re-alignment
- capacity building
- the water management programmes included in this Strategy

Invest in specific priority programmes: The water sector, led by the DWA in partnership with relevant sector stakeholders, will invest in the strategic priorities identified in this NWRS2, including water conservation and water demand management, improved operations and maintenance, water resource protection, improved governance, capacity and skills, and infrastructure where the requirement has been proven within the Reconciliation Strategy frameworks.

Funding model: The water sector, led by the DWA in partnership with relevant sector stakeholders, will develop an appropriate funding model in support of the institutional arrangement investment framework. The DWA will liaise with National Treasury, the private sector and other sector partners to develop appropriate funding models that will support multi-purpose social and economic investments.

Private sector participation: The private sector will be mobilised to fully contribute towards the funding requirements of economically viable projects and multi-purpose projects will, as a norm, be funded by both the public and private sectors.

Appropriate technology and value engineering: All sector stakeholders, including the DWA, water services authorities and providers, water boards, TCTA, catchment management agencies and water user associations will value engineer all of their investment decisions against cost and functionality.

12.4.2 Sustainable financial management and administration

Capacity building coordination with SETAs: The DWA will coordinate with the relevant SETAs to ensure that the skills development levies collected from the water sector are invested in capacity building that supports the sector.

Improved financial management: The DWA will mobilise the sector to implement a national programme for collecting outstanding water charges from water users and to improve financial management. The DWA will also establish a debt management desk to support municipalities and water boards to recover their costs. It will also implement a turnaround strategy for the management of the National Water Trading Entity. The turnaround will include improving systems for the WARMS registration, billing of water charges, revenue collection and reporting.

12.4.3 Improved financial governance and regulation

Improved financial governance: The DWA will mobilise the sector to improve financial governance in all institutions. Corruption and fraud will be dealt with decisively.

Economic regulation: The DWA will establish a regulation function responsible for, among others, regulating water charges and tariffs from source to tap, as discussed in **Chapter 9.**

12.4.4 Equitable water pricing

Pricing Strategy for Water Use Charges (Pricing Strategy):
The DWA will, in consultation with its sector partners, review the Water Use Pricing Strategy to promote the principles set out in this chapter, including those of social equity and ecological sustainability.

Waste Discharge Charge System:
The three priority catchments that have been identified as pilots to implement the WDCS (the Upper Crocodile River West the Upper Vaal River, and the Upper Olifants River) will be used as test cases to formulate general guidelines and strategic support for the implementation of the mitigation charge of the WDCS in other priority catchments.

Implementation of the Waste Discharge Levy and disbursement of the revenue is dependent on the establishment of the levy in terms of a Money Bill, still to be prepared for consideration by Parliament. The DWA will support the Minister of Finance in this regard.

Norms and standards for water services tariffs:
The norms and standards for water services tariffs will be revised and further developed to provide for water supply and sanitation services by municipalities, and bulk potable water supply by water boards. The norms and standards will also provide for ring-fencing of local government water services revenue and cost reporting. The norms and standards already have a pro-poor component and this will be strengthened.

Financial support to water based rural livelihoods and food security for all:

The DWA will in partnership with sector stakeholders, develop a strategy to provide financial support for the creation of water-based, vibrant, equitable and sustainable rural communities and food security for all. The financial support will include:

- Funding of socio-economic studies
- Acquisition of water-use entitlements for both irrigation use and for non-agricultural water-based small enterprises
- Capital costs of bulk water infrastructure and rainwater harvesting
- Subsidies for water-use charges instead of the operations and maintenance of schemes

CHAPTER 13
MONITORING AND INFORMATION MANAGEMENT

13.1 Context and current challenges

13.1.1 Context

The collection of data and the interpretation of information on water are critical to all aspects of water management. Without accurate information, the correct picture of the water situation cannot be determined and policy formulation could be compromised. Hence, information based on well-organised monitoring programmes is a prerequisite for accurate assessments of the status of water resources and the magnitude of water problems[1].

Monitoring is necessary to collect sufficient and accurate data to inform decision making, and reduce and manage risks. Therefore the ultimate goal is to provide information needed for planning, decision making and operational water management and related infrastructure at local, national and regional levels. Monitoring programmes are also fundamental for protection of human health and of the environment. Chapter 14 of the National Water Act (1998) advocates the establishment of national monitoring systems; whose purpose it is to facilitate the continued and co-ordinated monitoring of various aspects of water resources by collecting relevant information and data.

What is meant by water data and information?

Water refers to water in any stage of the water life cycle
Water information refers to data or value-added information products that relate to the occurrence, spatial and temporal distribution, quality, quantity, movement, use (actual, authorised or registered), compliance to management and transformation objectives and the cost of surface and groundwater as well as any metadata related to these.

Monitoring is done by the Department of Water Affairs, other water Management Institutions under the Minister of Water Affairs and other institutions and individuals in the water sector, all of which operate at international, national, regional, catchment and local levels.

The primary goal is to collect accurate data on all aspects of water management. This also involves implementation of comprehensive monitoring programmes that serve all needs for information on water management. This includes quantity and quality and addresses rainfall, streams, rivers, reservoirs, wetlands, estuaries and groundwater. The aim is to provide information for the allocation, regulation, pricing, cost recovery, control, compliance monitoring and enforcement at local, regional and national levels and for internationally shared waters.

[1]Taking responsibility for water: United Kingdom Water Research and Innovation Framework 2011 - 2030

13.1.2 Current situation and challenges

Currently, a number of databases in major national water monitoring programmes are in progress, 11 of which are operated by the DWA. These include:

- Surface water data (including streamflows, rain, evaporation and reservoirs) in the HYDSTRA database
- Groundwater data in various databases, including NGA, WARMS, GRIP, HYDSTRA and Hydrogeological maps
- Fitness for use data in the National Microbial Water Quality Monitoring Programme, National Eutrophication Monitoring Programme, National Toxicity Monitoring Programme, Rivers database, WMS, NGA/REGIS, HYDSTRA and geographical information systems (GIS)
- Water-use data captured by the DWA in the Water Registration Management System (WARMS)
- Compliance and performance data in the Regulatory Performance Management System
- Gauged rainfall data, primarily in the South African Weather Service (SAWS) database, but also available from others such as the Agricultural Research Council (ARC), water boards, local and district municipalities, WUAs, etc

Section 68 of the Water Services Act provides for the Minister of Water Affairs to establish and maintain a national information system to record and provide data on the development, implementation and monitoring of national policy on water services and to provide information to water services institutions, consumers and the public. Section 69 stipulates that the Minister may require any province, water services institution and consumer to furnish information to be included in the national information system. As water services authorities and, in most instances, water services providers, municipalities collect, store and manage data and information on water services provision either on their own or in conjunction with private service providers. For various reasons, including lack of institutional capacity, some municipalities have struggled to report this information timeously.

There is a need to expand the current coverage of water data and information because it is inadequate in some areas; for example, insufficient groundwater monitoring points with an inadequate spatial distribution. Current reporting about the availability and use of water is also not sufficiently covered with regard to water, accounting on how water supply is balancing demand to meet transformational imperatives.

Data sharing between stakeholders in the water sector is insufficient, resulting in information needs not being satisfied as well as they could be even under present circumstances. There is an urgent need for a well-designed, coordinated and managed programme for collecting, assessing and disseminating data and information on water recorded by all entities in the water sector, including state departments, provincial governments, municipalities, water management institutions and water services authorities and -providers, as well as by water users.

The sharing of hydrological data and information with neighbouring countries in shared river basins is becoming increasingly important. Hydrological information regarding flood situations, drought flow conditions and the consequences of climate change in shared water courses is particularly important. Monitoring and information management in trans-boundary river basins and aquifers has not been sufficiently synchronised for effective joint river-basin management.

The 2004 NWRS envisaged a single extensive, integrated, accessible water information system[2]. Although progress has been made in this regard, there are still many separate water information systems, both within and outside the DWA, which function as standalone systems with limited accessibility. The main data archives and information databases are well maintained, with extensive upgrades, including a number of data retrieval functions which are now available on the internet.

13.2 Principles

The implementation of the strategy in relation to monitoring and information management is guided by the following principles:

- An integrated, easily accessible monitoring and information management system that supports sustainable water management.
- Data on water must be collected, managed and protected as a strategic asset.
- The recording of observations on all elements of the water value chain is essential for effective water management and inter-institutional collaboration.
- The effective use and exchange of data on water requires compliance with universal standards and world best practice to align South Africa with international reporting.
- Monitoring and information management in a decentralised, participatory and multi-sectoral environment requires an effective level of governance and coordination.
- Water data and information needs to be accessible at all levels of the public, empowering it to exercise its constitutional rights.
- Adequate skilled human resources are vital to ensure consistent quality of hydrological data.
- Adequate and reliable funding is a prerequisite for the sustained and continued monitoring of water resources.

13.3 Objectives

The strategic objectives in relation to monitoring and information management are to:

- Develop and implement a national monitoring and information management plan to compile and maintain easily accessible and accurate data to support decisionmaking, reduce and manage risks and deal with emerging climate change impacts.
- Raise awareness of the importance of investing in the collection and management of high-quality water-related information for supporting water resource management.
- Improve governance of monitoring and information management in the water sector.
- Ensure uninterrupted continuation of existing monitoring programmes.
- Improve and enhance the quality of data and information on all aspects of water.
- Develop a high quality, integrated information management system for the water sector.
- Generate beneficial integrated water information products.
- Improve access to and dissemination of water data and information.
- Ensure that adequate skills and human resource capacity for monitoring and information management is developed.
- Develop and implement a viable and adequate funding model for monitoring.

13.4 High level strategic actions

13.4.1 Monitoring

Develop and implement an integrated national information management plan for the entire water sector that is easily accessible to government institutions and to other users. This plan must include following:

- Planning and implementing water resource development and water services infrastructure
- Monitoring for compliance
- Monitoring for early warnings to avoid, limit and mitigate risks in water management

13.4.2 Data sharing

Prioritise the development of protocols for data collation from different sources, ensuring data integrity, data sharing platforms and the standardisation of data parameters. Form partnerships and inter-governmental cooperation agreements for data sharing.

13.4.3 Information systems

Clarify the funding model for the development, extension and maintenance of information systems. Establish a special forum to scope the needs for information systems and new research in the water sector.

[2]Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters. Economic Commission for Europe, 2006

13.5 Other supporting actions

The following actions will be taken to effectively implement this component of the NWRS2:

- Establish a comprehensive plan to improve water supply and demand-related information on a national scale for catchment-based water accounting.
- Develop and implement a national educational campaign on water monitoring and information management in support of new imperatives like protection, demand management and the conjunctive use of surface and groundwater, among others.
- Establish fully functional and well-equipped regional information centres.
- Design appropriate models for dealing with quality parameters other than salinity.
- Ensure that data are captured into a national system using web-enabled data capturing systems, where appropriate.
- Build an integrated water information and dissemination system that facilitates sharing of water quality and quantity information with all in the water sector, including individual users and the public.
- Develop and implement national monitoring and information management governance in the water sector.
- Address research needs on water monitoring and improve the distribution of information on research outcomes as a matter of urgency.
- Increase investments in gauging stations and operational infrastructure to improve data on rainfall and groundwater levels.
- Ensure the continuation of monitoring and data acquisition programmes by providing adequate funding and appropriate skills capacity.
- Establish a management and maintenance system for monitoring infrastructure.
- Develop a data and information-sharing protocol.
- Set national standards for monitoring in the water sector, with a focus on the fitness for use of water, frequency of data measurement and capture, and location of sampling stations.
- Standardise and optimise monitoring programmes and maximise the utilisation of the resources allocated to these programmes.
- Ensure adequate monitoring, early warning facilities and decision support systems for each water supply system, supported by the orderly processing and secure storage of the data and information that is collected and processed.
- Put in place, by 2019, a system for the effective collation of data from all water sector institutions, including CMAs, into an easily accessible national water resources information system.
- Make better use of advanced and appropriate technologies in water monitoring and information management.
- Ensure that high-quality data and information for supporting scientific research, regulation, monitoring and compliance enforcement are made accessible to public and private institutions, and produce reports for decision-makers in support of the "Water Footprint" concept[3].

[3]The water footprint of a nation shows the total volume of water that is used to produce the goods and services consumed by the inhabitants of the nation

CHAPTER 14
RESEARCH AND INNOVATION

14.1 Context and current challenges

Research and innovation has been a major contributor to being able to meet the ever increasing demands for water in South Africa. The development of skills in the water sector and high-level knowledge about water is still a priority for rapid progress to be made in ensuring that all citizens of the country have safe and secure access to water of good quality.

14.1.1 Background and NWRS1

The NWRS1 acknowledged that research has been a fundamental contributor to understanding South Africa's water resources and developing many of the techniques and tools, including enabling legislation, used for their management. It also confirmed the leadership role of the Water Research Commission in continuing to ensure that the strategic direction of water research in South Africa is attuned to the country's needs, that water-related research and development in South Africa is adequately funded and coordinated, and that knowledge so generated is appropriately disseminated and applied.

Emphasis was placed on the desirability of close ties between the WRC and the sector leader, the DWA, to ensure that the latter's research needs are known, and between the WRC and the Department of Science and Technology (DST) and the National Research Foundation (NRF), to ensure that approaches to water research are consistent with South Africa's broad policy on science and innovation.

An apparent omission from the 2004 NWRS1 is reference to the DWA's roles and responsibilities regarding research and development, as envisaged by national science and technology policy. The DWA, as the sector leader, has the primary responsibility for liaison with DST and for the drafting of a sector Research and Innovation (R&I) strategy that meets the needs of the sector and dovetails with the national R&D (research and development) policy and strategy.

14.1.2 Key issues requiring attention

While much progress has been made with regard to research since the promulgation of the Water Research Act (Act 34 of 1971), the following key strategic issues still require attention:

- Sustainable utilisation of groundwater resources
- Development of human research capacity
- Degradation of water quality and water ecosystems resulting from industrial and agricultural development, mining and rapid human settlements in peri-urban areas
- Increased health risks to humans and animals as a result of contamination of water by hazardous pollutants
- Uncertain impacts of climate change on the availability of water
- Insufficient provision of basic water supply and sanitation to some rural areas
- In-equitable access to water for productive use
- Lack of alignment of water research objectives, thrusts and programmes with the broader national policies and strategies relating to water resources management and water use
- Limited participation of sector-wide stakeholders in the setting and execution of the water-related research and innovation agenda for the country
- Availability of skills and expertise in water research
- Insufficient allocation of financial resources for water sector research and innovation

14.1.3 Policy development, dissemination and collaboration

The government, research institutions, academic institutions, non-profit organisations, and all water users should contribute to effective decision-making in water use and management. This is only possible when supported by coherent and consistent policies and the coordinated dissemination of new knowledge, new technologies and skills. There is currently not sufficient evidence that the sector benefits from research in terms of policy development.

More than half of water research activities, funded and coordinated through the Water Research Commission are conducted by universities, science councils, organs of state, the private sector, water utilities and other agencies such as the CSIR. A number of water role players make significant and independent input, such as Eskom, Sasol, mining and agricultural companies. Hence, the consolidation of collective intelligence, enabling the development of a comprehensive inventory of all water-related research nationally, is of strategic priority.

14.2 Principles

The following principles guide the implementation of research and innovation for the water sector:

- Research and innovation is focussed and aligned to achieve an overall vision.
- Research and innovation should be well coordinated within the sector and the coordination role must be well established.
- Research and innovation cuts across traditional research boundaries in line with agreed high-level objectives.
- Research and innovation should be geared towards aligning products, services and knowledge that will contribute to practical solutions to issues in the water sector and thus promote sustainable development.
- Knowledge derived from water research must inform policy development and strategic decision-making at all levels of government and across the water value chain.
- Transformation, equity and empowerment of marginalised groups inform the design of research and development projects.

14.3 Objectives

The following objectives have been identified for addressing the issues outlined above:

- Develop a critical mass for knowledge development and exchange. Use water research as a catalyst for developing high-level human resource capacity for the water sector.
- To contribute to effective and efficient water management, solutions that respond to the needs for water security and sustainability for individuals, communities, productive use, strategic water use, and ecosystem services.
- Ensure inclusive, coherent and well-coordinated participation by all role players in water-related research and innovation.
- Develop mechanisms to ensure that water information and water research outputs are beneficially applied in improved water management and for effectively dealing with other challenges facing the water sector.
- Ensure that research and innovation in the water sector are adequately resourced and that resources are used efficiently and effectively.
- Draw on and protect indigenous knowledge for research and innovation in the water sector.
- Find innovative approaches for dealing with the high levels of complexity in the water sector, with a long-term and transformative thinking; for example, in the implementation of WAR.
- Provide knowledge and foresight on potential future challenges, especially those caused by climate change, likely to arise from population growth, energy consumption, changing economic conditions and political changes.
- Promote innovation and business development from the results of water research.
- Promote greater inclusivity and better coordination and coherence within the current national water-centred R&I system, which has served the country well in the past.

14.4 High-level strategic actions

14.4.1 Develop a national plan

A National Water Research Plan that covers the entire innovation value chain will be developed. The plan should include a strategy that can articulate the priority research infrastructure areas of a national scale (capacity areas) to further develop the national research capacity and improve research outcomes over the next five to 10 years.

14.4.2 Improve utilisation of outputs

Develop mechanisms to ensure that water information and water research outputs are protected, accessible and beneficially applied in improved water management and for effectively dealing with other challenges facing the water sector.

14.4.3 Clarify roles and mandates

Relationships and reporting lines between institutions that are involved in R&D within the sector will be clarified and improved to achieve the broader objectives of the NWRS2.

14.5 Other supporting actions

The following actions will be undertaken to support the effective implementation of the NWRS2:

- Develop a National Water Research Plan that covers the entire innovation value chain (idea generation, idea conversion and idea diffusion) and includes contributions from the social sciences, economics, natural sciences and engineering disciplines to research and development in the water sector. The plan will seek to forge closer links between research, innovation and implementation and to provide mechanisms for monitoring outcomes to inform the design of research.
- Develop centres of excellence in water research around the country that consider specific needs in the various geographical areas.
- Compile a comprehensive inventory of existing water-related research, water researchers and research institutions and develop a protocol for collaboration in water research locally, nationally and internationally.
- Promote innovation in the private and public sector for pilot projects, support of knowledge sharing and for rewarding outstanding achievements in innovation through awareness creation of existing national innovation support structures.
- Strengthen links between the DWA and DST to facilitate the integration of water-sector research and innovation into the National Research and Development strategy and into the National System of Innovation.
- Align water R&I objectives, thrusts and programmes with the broader national policies and strategies relating to water resources and water use.
- Promote the transfer of technologies and tools for the benefit of the water sector and the alignment of applied research priorities throughout the water value chain to ensure that water research directly contributes to the resolution of water sector challenges across the board.
- Investigate and improve funding for water research.
- Develop new approaches and strategies to promote, protect and use indigenous knowledge for research and local innovation in the water sector.

CHAPTER 15
WATER SECTOR SKILLS AND CAPACITY

15.1 Context and key challenges

The National Water Resource Strategy, First Edition (2004) argues that, "Strategies to give effect to the provisions of the National Water Act (the Act) will not be effective if there are too few competent people available to implement them. It is imperative to ensure that sufficient capacity is created in the water sector to implement and sustain the implementation of water policy and legislation".

Against this background, this chapter of the NWRS2 serves as one of the enablers for the achievement of the national development imperatives as well as the water sector strategic objectives outlined in **Chapter 3** of this document and detailed in each of the chapters.

15.1.1 The skills development mandate and challenges in the water sector

While skills and capacity are key to the implementation of the NWRS2, recent reforms within government have placed the responsibility for the coordination of education, training and skills development across various sectors in the Department of Higher Education through the various Sector Education and Training Authorities (SETAs).

For the water sector, the Energy and Water Sector Education and Training Authority (EWSETA) is charged with the responsibility of coordinating and facilitating skills development and capacity building in accordance with the Skills Development Strategy III, Human Resource Development Strategy II (2010-2030) and the New Growth Path National Skills Accord (NSA) between government, business and labour. Through its Sector Skills Plan, the EWSETA focuses on:

- Determining skills development priorities after an analysis of the skills demand and trends, level of skills required and supply issues within the sector.
- Identifying a set of water-sector-specific objectives and goals that will meet water-sector needs, economic or industrial sector growth strategies, and address scarce and critical skills in the sector.
- Identifying strategies, activities and resources to address sector skills development objectives and goals.
- Reporting on the implementation of the sector skills plan.

The water sector has a multiplicity of stakeholders and role players who represent various interests and mandates in relation to capacity building, training and skills development. Such stakeholders represent government, education and training institutions and agencies, water sector institutions, water users, support agencies and institutions as well as civil society organisations.

Key skills and capacity building issues within the water sector

- Lack of a coordinated mechanism for the planning, delivery and quality assurance of water-related capacity building, training and skills development programmes within the sector.
- Existence of multiple education, training and skills development providers within the sector (within formal education, post-school and the work place)
- Absence of sector skills intelligence hub.
- Lack of capacity to deliver qualifications that meet the needs of the water sector among education and training institutions.
- There is a gap between higher education training, qualification and professional registration, with the period between the latter two ranging between three to five years.
- There is inadequate human resource planning within the sector; for example, lack of succession planning, weak retention strategies and the inadequate induction of professional entrants.
- The levels of water literacy and awareness among members of the public are very low, resulting in efficient water usage and wastage.
- Education, training and skills development are provided within a complex National Qualifications Framework and regulatory system and the practical alignment of the three sub-frameworks and the Quality Councils remains a challenge.
- Absence of a Water Occupations Framework as a tool to guide the planning and classification of occupations within the sector.
- Education, training and skills development within the sector is funded through a multiplicity of mechanisms, which result in overlaps or under-investment in critical areas.
- There is a shortage of specific critical skills within various institutions across the water value chain (engineering skills, artisans, socio-economic, environmental health, and management skills).

The EWSETA Sector Skills Plan (2011-2016) highlights the following skills gaps:

- Approximately 3 000 engineers (a 57% vacancy rate);
- About 7 200 health and hygiene/environmental health practitioners in the medium term and an immediate need for 125 new environmental health practitioners as well as for 150 to upgrade their skills;
- About 23 000 management staff (at least 1 200 in technical management positions; that is, engineers with management skills or managers with technical skills). Of these, 1 400 are requiredimmediately, 246 of which are construction project managers, construction managers, engineer managers and technical project managers (21% of total required technical management skills);
- A long-term need for an additional 12 000 staff with developmental and financial management skills; and
- An urgent need for 4 000 artisans / technicians.

Notwithstanding the issues and challenges reflected in the text box above, the sector has made considerable progress towards addressing the skills and capacity gaps throughout the water value chain. A number of initiatives have been initiated and implemented by various stakeholders within the sector, including those listed below.

15.1.2 Masibambane Civil Society Support Programme

The programme has funded courses that include the advocacy, water resource protection, water conservation and water demand management, water services regulation and sustainable livelihoods. The replication of these activities remains a challenge due to inadequate knowledge management, knowledge transfer and related capacity building mechanisms. Improvements in these areas can contribute significantly to water literacy and knowledge equity, as well as empower stakeholder groupings to participate in effective governance, protection and socio-economic aspects of the NWRS2.

15.1.3 Water literacy and public education programme

The Department of Water Affairs has continued to implement the national water literacy and public awareness programmes (the 2020 Vision Curriculum Support Programme as well as Baswa Le Metsee, Aqua Enduro and Public Speaking). The 2020 Vision for Water and Sanitation Education Programme in schools has reached over 20 000 learners and includes the annual Baswa le Meetse Awards.

15.1.4 Sector collaboration and intergovernmental relations

Through sector collaboration under the auspices of the Water Sector Leadership Group (Skills Development Task Team), the sector has developed a framework for education, training and skills development within the sector. The framework has informed a number of initiatives by various stakeholders within the sector, and serves as the basis for the approach employed within this chapter.

15.1.5 DWA Learning Academy

The DWA Learning Academy continues to offer bursaries and to develop interns (engineers and scientists) with the ultimate goal of registering them as professionals after three to five years. The academy has won the Billiton prize for the Best Capacity Building Programme in 2012.

15.1.6 Professionalisation of the sector

A number of water-sector stakeholders (for example, DCoG, LGSETA and WISA) have initiated programmes aimed at the professionalisation of the various aspects of the water value chain. The LGSETA is currently re-designing their process controller training course in alignment with the Quality Council for Trades and Occupations (QCTO) sub-framework, the DCoG initiative focuses on local government in its entirety, and the WISA programme is aimed at the professionalisation of process controllers, particularly focusing on:

- Mapping career pathing for the process controller occupation to give it more integrity
- Developing the Occupational Code and register it in the Organising Framework for Occupations
- Developing occupationally-based awards for the Process Controllers and register in the National Qualifications Framework (NQF)

15.1.7 Sector skills planning

The EWSETA has developed a Sector Skills Plan (2011 - 2016) in line with its new mandate and has commenced with the implementation of short- to medium-term initiatives in partnership with various stakeholders within the sector. Such initiatives include supporting FET colleges to access training materials from accredited training providers, the provision of bursaries for learners and engaging such agencies as the Municipal Infrastructure Support Agency (MISA), water boards and learning academies to open opportunities for workplace learning for students within FET colleges.

Through the University of Stellenbosch, the EWSETA is conducting a baseline study to establish and understand the FET college landscape (locational advantages, curricula, capacity and skills gaps, existing funding models, current qualifications, infrastructure and systems as well as demand and supply issues). This is envisaged to enhance the EWSETA's understanding of the FET college environment and to inform the design of targeted institutional capacity building programmes in the future.

15.2 Principles

The water sector's efforts in relation to capacity building and training for the implementation of the NWRS2 are guided by the following principles:

- Water sector capacity building is located within the context of integrated water resources management (IWRM).
- The skills and resources within established and capable water institutions will be protected.
- Skills and expertise within the sector will be optimised to create institutions that are capable of attracting and retaining skilled people.
- Capacity will be developed to address all the institutional elements of water resources and water services functions (development, regulation, management, financing and service delivery).

15.3 Objectives

The overall objective of this strategy is to put in place a well-coordinated, coherent capacity-building system within the sector. This will be supported by the following specific objectives:

- To strengthen the strategic orientation and coordination capacity of the EWSETA and LGSETA to ensure a demand-driven skills planning mechanism that caters for short-, medium- and long-term sector needs.
- Development of management capacity needed to support good water governance in all water institutions.
- Strengthening the existing mechanisms and processes for the DWA to provide strategic sector leadership in capacity building and training.

- Establishment of a sector supported institutional model for the effective coordination of institutional capacity building, education, training and skills development (formal and informal).
- Development of an inclusive strategy for the professionalisation of water sector institutions and practitioners throughout the water value chain, including regulations, standards, professional registration and on-going development programmes such as mentoring, coaching, seminars and short courses.
- Development of a sector skills intelligence facility that prioritises present and future skills needs within the three formal education bands and throughout the water value chain.
- Strengthening partnerships for innovation between role players along the skills pipeline (schools, FET colleges and HEIs), public and private providers, providers and workplaces, and between local and international providers (in areas where South Africa does not have the relevant expertise).
- Maintaining a balance between short-term imperatives for informal and non-formal interventions (targeted and task-specific, on-the-job training, coaching and mentoring) with long-term organisational and individual development through more formalised programmes.
- Finding, engaging, harnessing and developing un-utilised or under-utilised capacity in the sector, including tracing past graduates and recognition of prior learning for semi-skilled artisans and professionals.

15.4 Approach to skills development and capacity building

The sector capacity building and skills development framework is based on a systems or pipeline approach, prioritisation of skills as well as a partnership-driven approach.

Systems or pipeline approach:
The systems/pipeline approach recognises that skills are produced over many years by an education and training system. The system begins at pre-primary level, through the general education and training, further education and training as well as higher education and training bands, and covers the occupational learning sphere. The approach proposes a strategic intervention in each of the blocks that constitute the education and training pipeline with the understanding that the effective functioning of the system produces work-ready graduates insufficient numbers required by industry. These work-ready graduates enter the workplace and have sufficient mentoring programmes and exposure to training and development, which enables them to become productive professionals that will eventually contribute to service excellence and innovation. However, when the sector experiences skills shortages and a poor quality of new entrants, key problems can usually be traced back to about six or 10 years into the education and training pipeline.

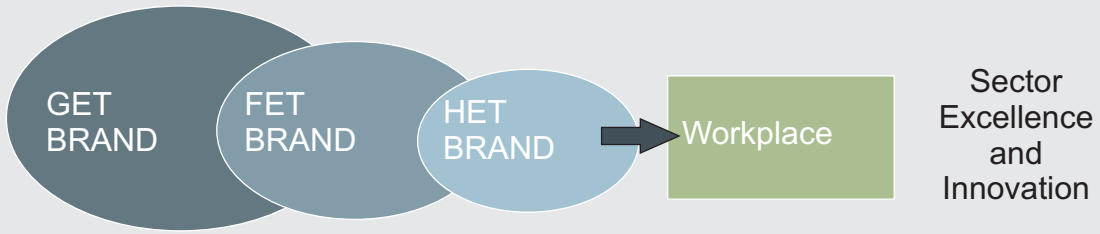


Figure 21: The pipeline approach

Prioritisation of skills:
The systems/pipeline approach will ensure that there is a blanket reach into the education and training pipeline, but specific interventions of the framework relate to critical skills. Focus is put on four key areas that have been identified (engineering and sciences; artisans and process controllers, socio-economic and environmental skills as well as emerging professions). In this way, the framework allows for sustainable interventions that will produce results in the medium to long term (through the systems approach), as well as for immediate interventions that can remedy the current lack of skills.

Partnerships:
The implementation of the framework will require robust partnerships where stakeholders can have specific roles and responsibilities towards a common objective, with the Department of Water Affairs playing a strong sector leadership role. Linked to this, a comprehensive coordination process and system will also be provided by the sector leader.

Figure 22 provides a schematic representation of the framework outlined in the previous paragraphs.

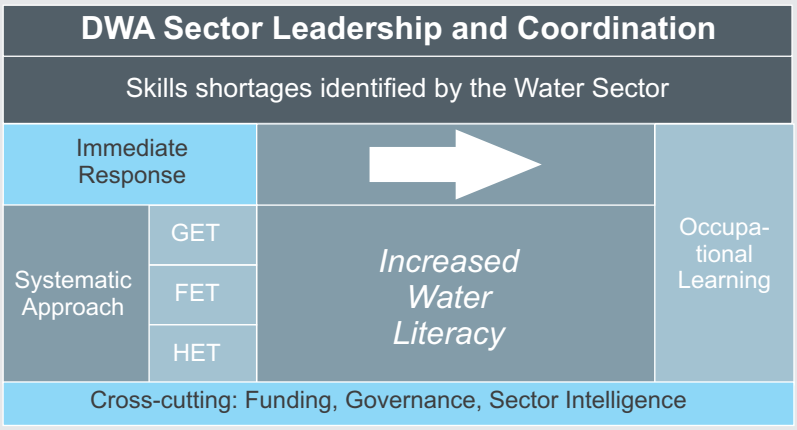


Figure 22: Framework for water capacity building and skills development strategy (Source: Water Sector Education and Training Strategy, 2012)

In implementing the framework, sector stakeholders will play their various roles in accordance with their respective mandates (planning; coordination; intelligence management; public awareness, education and advocacy; quality assurance and resource mobilisation).

15.5 Strategic actions

The strategic actions that will be undertaken towards the achievement of the set strategic objectives are outlined in this section.

15.5.1 Mapping of role players within the sector

Identification of roles and responsibilities in education and training (within each band of the education and training pipeline as well as the workplace; across the three spheres of government; within the water value chain; between civil society as well as the public and private sector). The process will entail an assessment of core mandates of institutions or organisations, locational advantages, strengths, as well as capacities, accountability lines, interdependencies and models for resource allocation.

15.5.2 Establishment of a coordinated skills planning, funding and monitoring mechanism

The EWSETA, in collaboration with the DWA and other sector stakeholders, will drive skills planning within the sector in line with the policies and strategies highlighted in Section15.1 of this document and on the basis of the pipeline approach. This will be informed by a deeper understanding of the current and future demand for critical skills and emerging skills requirements within the sector.

- **Long-term human resource planning:** The DWA will champion a programme for the promotion of long-term human resource planning, the design of skills retention strategies and the creation of an enabling environment for healthy movement/rotation of skills within water-sector institutions.
- **Skills intelligence hub:** Establishment of a skills intelligence hub to support skills planning, curriculum development, decision-making, coordination and quality assurance within the sector.
- **Effective and efficient funding model:** The DWA will work with National Treasury and the water sector as a whole to design a sector skills funding model that seeks to optimise various funding mechanisms and sources (public and private), but that employs a differentiated approach towards the funding of education, training and skills development within the sector
- **Focusing on water sector priorities and needs:** As a sector leader, the DWA will ensure that skills planning and prioritisation processes are informed by sector strategic goals and needs, while seeking to foster linkages between training providers and places of work. This will include the assessment and development of skills required for the implementation of water sector priority programmes; for example, water use licensing planning, water conservation and water demand management and water allocation reform.
- **Monitoring and evaluation:** Development of a monitoring and evaluation system for sector capacity building and training, integrating all the bands within the pipeline and based on the Sector Skills Plans of the LGSETA and EWSETA and the Workplace Skills Plans of various water sector institutions.

15.5.3 Strengthening linkages between education and training institutions and places of work

The LGSETA and EWSETA will facilitate close and functional links between water-sector institutions, professional bodies as well as education and training institutions to address registration and experiential learning bottlenecks in line with the New Growth Path Skills Accord. The DWA will also work with the Department of Higher Education and Training, through its relevant quality councils, to ensure that the HET syllabus is aligned more closely with the requirements of water sector institutions.

- **Public sector leadership and management:** Engaging the Public Administration Leadership and Management Academy (PALAMA) to ensure that water sector management needs are included in the planning of public sector management courses and support the enrolment of water sector managers in such courses.
- **Councillor development programme:** A dedicated programme for municipal councillors will be designed to empower and capacitate them on their political roles with respect to water services business within their municipalities as well as to promote their involvement in water resource management issues.
- **Building sector knowledge production capacity:** The DWA will work with the Department of Higher Education, the SETAs and DST to support investment in knowledge production and innovation capacity within education and training institutions, science councils, state-owned enterprises and private sector organisations. This will be coupled with efforts to ensure the timeous identification of the training and skills requirements for the application of the latest technological innovations and tools required by the sector.

15.5.4 Public awareness and water literacy

Implementation of a public awareness and water literacy programme, with a particular focus on efficient water use and management. The utilisation of untapped mass media potential as a mechanism to promote water literacy and raise public awareness regarding the value of water will be explored.

15.5.5 Intergovernmental relations, sector collaboration and partnerships

Effective utilisation of existing structures and instruments to facilitate intergovernmental relations, sector collaboration and partnerships in addressing key education, training and skills development issues.

CHAPTER 16
EMERGING POLICY ISSUES AND IMPLEMENTATION OF THE STRATEGY

16.1 Emerging policy issues

This NWRS2 is based on the current NWA of 1998 but, while reviewing the NWRS1, it became clear that there are a number of emerging policy issues that could not be included as strategies in the NWRS2 as the current legislation does not make provision for these.

The Minister of Water and Environment Affairs has announced in Parliament a Policy Review Process to address the formulation of new water policies, including these emerging policies that will eventually lead to legislative amendments or even an integrated Water Act, thereby combining the NWA and the WSA.

Developments and changes occur all the time and sometimes require different solutions than may be presently held. Global and national priorities are always shifting and the water environment is not immune to the impacts of government and environmental outcomes that evolve. The present and future water agenda may not be always solved with past knowledge and experience because the conditions within the environment are rapidly evolving.

The South African context:

- Issues have emerged within the water resource management environment in which policy is not definitive and is thus unable to effectively ensure sustainable management of water resources.
- The impact of change in the environment is not confined to water issues, but extends to socio-political and socio-economic imperatives that, from time to time, warrant a review in terms of the macro goals of the country.
- Emerging scenarios could impede effective service delivery and sustainable management of water resources if not addressed through a policy statement from the DWA and through the Minister's guidance.
- In line with the provision in the Constitution (Act 108 of 1996) that national government is the custodian of the sources of water, such as rivers, groundwater and dams; and the Minister of the Department of Water is given the mandate by the National Water Act to act on behalf of the nation, to protect, use, develop, conserve, manage and control water resources as a whole.

This chapter explores various scenarios and gaps where either amendment is needed or there is no definitive policy guide, and highlights barriers to implementation on the existing policy framework. The NWRS2 may not be the platform where emerging policy issues will be resolved, but it presents an opportunity to raise them for consideration so that they can be subjected, if warranted, to the policy review process.

16.1.1 Revision on water legislation

The National Water Act and Water Services Act should be revised and combined into a single coherent piece of water legislation that addresses the entire water value chain. This will follow once the Policy Review Process discussed above has been completed.

16.1.2 Water off setting

Due to the scarcity and demand on water, government sets industry limitations on the extent of the use of water in terms of quantity and quality, the main focus being that of achieving effective and beneficial use of water and on minimising the pollution of the resources. As a result, municipalities, businesses and public owners are making significant investments in reducing water usage and improving effluent quality compliance. However, at some stage, a point of 'diminishing returns' is reached, with industry facing a situation of having to make substantial investments to obtain relatively small water savings or meet effluent quality specifications.

Innovative ways and mechanisms are required to facilitate a process to redirect investment to where maximum impact would be achieved, within the requirements of the Act. Such process would provide an opportunity to users upstream of water resources to gain a larger water saving or assisting to meet effluent compliance specifications, thereby allowing more water to remain in the system. Although the NWA and the NWRS allow for mechanisms such as water offsetting and water trading, the concepts need to be refined and operationalised as part of a policy review process.

For this reason, the DWA will address such initiatives by the development and implementation of:

- A quantitative framework for a water-neutral scheme that allows a private- or public water user to balance its water account through both demand and supply-side interventions. The policy and operational framework will provide for mechanisms, incentives and, possibly, rewards for achieving this. It will aim to stimulate activities that optimise use efficiencies, and offset the negative impacts of particular uses that cannot be mitigated further. These offsets will hold the potential for a wide range of further benefits, including economic stimulus and job creation.

The policy framework will conform to the following overarching objectives:

- minimise the gap between the available water supply and demand nationally, particularly in water stressed catchments
- promote more water-friendly growth and development

- incentivise better stewardship and greater use-efficiency of our water sources
- raise awareness of the extent of competition for finite water supplies, the vulnerability of water sources, and the vital importance of pursuing greater use efficiency
- stimulate greater efficiencies through promoting measurement of water consumption, pollution and use impacts over the complete production and supply chain
- harness investment by private and public enterprises in water security

16.1.3 Reallocation of water rights (equity)

Equity is critical in ensuring that water reform in South Africa is realised. In the water sector, equity implies justice in the management of water, responding to social and economic needs of all South Africans. The existing legal framework and policy does not adequately respond to the objective of redress in terms of making water available and advancing equity considerations. It is imperative that provisions within the NWA should not only protect the interest of existing water rights but should also provide mechanism to make water available for redress.

There is thus a need to consider how the following factors affect the process of redress and achieving equitable allocation of water would be addressed within the policy review process by:

- Determining a reasonable time frame and duration for a licence and revising it accordingly.

- Revising the authorisation when the right has not been exercised upon with any cause or good reason. When the authorisation is not acted upon, it limits the opportunity to make water available for other important uses. There must be a process to revise authorisations when there is redundancy or no use of available water to provide access to water for re-allocation to other equity considerations.

- Ensuring that any transfer of water serves the purpose of the Act in terms of redress and equity in particular.

- Exploring and revisiting the issue of existing lawful use and how it should be modified to enable faster redress and equity achievements without unfairly penalising current water users.

On revision, the National Water Policy should develop policy proposals that will ensure equitable water allocation and enjoyment of water benefits by all.

16.1.4 Appeal process, including the Water Tribunal

The Water Tribunal is an independent body, whose members are appointed through an independent selection process, and which may conduct hearings throughout the Republic. The NWA stipulates in Section 149 (1) (a) that a person may appeal to a High Court against a decision of the Tribunal on a question of law. This chapter also provides for disputes to be resolved by mediation, if so directed by the Minister.

The appeal process does not consider the intricacies in terms of the legal processes and strategic goals aligned to the authorisation process in terms of equity and redress or other court decisions which might have a significant impact on the hydrology patterns, volume of water and catchment management.

There is a need to consider the implications of high court decisions and what competence might be required to make a judgement around intricate water management issues. A means for the court to provide recourse for reconsideration by a competent institution with a full understanding of water management issues or refer the matter back to the water tribunal for reconsideration might need to be considered.

This applies to decisions against the DWA and all statutory bodies established under the Act and reporting to the DWA or the Minister of Water Affairs.

There is a need to investigate challenges related to the Water Tribunal in terms of the effective execution of its mandate, and proposals to improve its performance should be submitted and considered by the Minister. An Advisory Committee may be established by the Minister to conduct such an enquiry.

16.1.5 Sanitation

Due to the centrality of water to life and local government service delivery imperatives, it is likely that most government policies and legislation would directly or indirectly have an impact on water resources management and, consequently, water services provision. Sanitation as part of water services, in general, falls within this category. The challenge with sanitation is that it is a competence of another Department (Human Settlements) at a national level and a local government responsibility in terms of implementation, but it has significant implications for water management.

There are obvious areas of integration between water and sanitation in terms of the whole water value chain management and this includes water-borne sanitation, wastewater treatment, operation and maintenance of infrastructure, on site sanitation and potential pollution of groundwater.

- This necessitates a structured mechanism, through which the Minister of Water Affairs can give input into the development of legislation and policies in general and regulations by various government departments in particular.

- An effective formal reporting mechanism on the water services function from Local Government to the Minister and means within the legal framework for the Minister of Water Affairs to take corrective steps in case of serious malpractice or negligence affecting effective water resource management in the country is required.

- This mechanism should be aligned to and be informed by each department's Regulatory Impact Assessment (RIA) processes, as outlined within the Guidelines for the implementation of the Regulatory Impact Analysis/Assessment process in South Africa, 2012, issued by the Presidency's Central RIA Unit (CRU).

- There is a need to align the Water Services Act with other national legislation that governs local government, particularly as they relate to development planning, regulation of water services provision (national and provincial intervention in local government), regulation of local government's reporting obligations in accordance with the provisions of national legislation, regulations, as well as the determination of norms and standards on issues of common interest.

16.1.6 Review of the roles and responsibilities of water institutions, including regional water utilities and water user associations

The National Water Act provides for the establishment and transformation of institutions to help the DWA to give effect to its core mandate. There are challenges that have been broadly documented regarding lack of accountable and efficient management of regional water infrastructure and also problems with the delivery of water services by local government. An institutional model needs to be considered that will adequately respond to the challenges related to bulk services which include the following:

- Weak performance in the management of water supply and sanitation services by many municipalities, which compromises services
- Lack of clarity regarding responsibilities for water resources development at the local and regional level, and for regional bulk services outside of the existing water board service areas
- Governance and performance-related problems within some of the existing water boards.

Consideration is being given to the consolidation of existing water boards into Regional Water Utilities to manage regional water resources and regional bulk water and wastewater infrastructure in terms of a mandate from the DWA. A proposal on the model to be considered should provide a rational basis for determining the number of Regional Water Utilities that should exist and the area of jurisdiction that they should serve to achieve optimum economies of scale.

16.1.7 Good water governance

Good water governance is a pre-requisite for water resource management. Without good governance, effective and efficient water management will not be an attainable. The revised National Water Policy should be concerned with the balance of power among different stakeholders with diverse water interests. Despite structural changes in water management at the local level, issues of equity remains complex and unresolved. Therefore, good water governance would be a step towards water equity. Good water governance entails, for example, integrated water planning, water cooperation, wise water usage, centrality of water, creation of effective water institutions.

There is a need to investigate how the concept of development of water management and the principle of inclusive governance and participation by stakeholders, especially communities as advocated in the NWRS2, is reinforced in the structure and processes of water management.

The governing structures and boards of many water institutions need to be constituted in a manner that includes the necessary skills and expertise needed for effective governance while still ensuring meaningful representation of all groups within the local water management area through appropriate forums. This should be an important consideration in the review of policy to achieve a sustainable and a democratic water governance model.

16.1.8 Hydraulic fracturing and coal bed methane extraction

The mining of shale gas and the associated hydraulic fracturing could bring enormous economic benefits to South Africa. However, hydraulic fracturing also poses a threat to already limited groundwater resources in areas such as the Karoo and will need to be strictly regulated, as such:

- The DWA will expand the regulatory framework to ensure that the limited available water source is protected from exploitation and pollution.
- Such a framework will be developed in close partnership with the WRC, the DEA and the DMR to lead to a policy that guides the conditions that will be imposed on hydraulic fracturing to ensure the protection of the groundwater resource as well as ensuring the yield of such sources.
- Coal-bed methane extraction is another emerging mining practice that can extract valuable gases from coal beds in areas such as Limpopo and Mpumalanga. The current regulatory framework and policies and legislation need to be amended to protect the water resource.

16.2 Priority focus areas for next five years

- Achieving equity, including Water Allocation Reform
- Water conservation and water demand management
- Institutional establishment and governance
- Compliance monitoring and enforcement (CME)
- Planning, infrastructure development and operation &maintenance of water resources infrastructure

16.3 Implementation framework

This NWRS2 provides the strategy for how the water sector and its key institutions will achieve the strategic objectives.

Detailed Implementation Plans will be developed to operationalise the strategy. The implementation framework below will guide the development the implementation plans.

A plan will be developed for each strategic theme (vertical dimension of **Table 8,** overleaf) so that the sector as a whole is able to see how each strategic theme will be implemented.

Plans will also be developed for each institution in consultation with the institutions concerned to ensure that the strategic themes are operationalised across the sector.

Each plan will address the following:

- Key milestones and performance indicators
- Strategic actions to achieve the milestones
- Activities to achieve the performance indicators
- Resources (budget and any other resources) required
- Person(s) responsible
- Time frame for implementation

Table 8: Framework for implementing the NWRS2

Responsible intitutions	Strategic theme						
		Planning, infrastructure development and management	Protection	Equitable water allocation	Conservation and demand management	International cooperation	Managing for climate change
	Minister of water affairs						
	DWA						
	National water resource infrastructure entity						
	Regional water utility						
	CMAs						
	International bodies						
	WUAs						
	WSAs						
	WSPs						
	Sector line departments						
	Agriculture sector						
	Mining sector						
	Industrial sector						

A plan will be developed for each institution that addresses how that institution will implement that NWRS2 and how it will contribute to each of the strategic themes

A plan will be developed for each strategic theme that illustrates how the theme objectives will be achieved across all the sector institutions.

Refer to Table 9 for an illustration of the approach.

Table 9: Implementation of NWRS2 priority themes

Strategic Priorities	Theme	Strategic objective/ Outcome	KPI/Target	Responsibility	Collaboration and sector support	Alignment with other programmes	Time Frames
	Infrastructure planning	Develop, update and maintain water Reconciliation Strategies for all water resource systems and towns under stress;	Finalise the following projects: Mbombela, Orange River, Richards Bay, Northern Limpopo, Luvuvhu-Letaba Maintain existing Reconciliation Strategies	DWA	All users and state institutions	SIPS, IDPs', PGDS	2017
	Water conservation and demand management	Achieve significant savings by all sectors	50% reduction in water losses	DWA, Mining, Energy, Municipalities, Private sector	CSO's, Media, CSIR Community, WRC, Department of Agriculture, Fisheries and Forestry (DAFF)	WR Planning, Reconciliation Strategy studies, authorisations	2017
	Equitable water allocation	Allocate water to historically disadvantaged and poor South Africans	200 000 ha	DWA, CMA's, WUA's	CMF, CSO's, unions, agricultural cooperatives, DAFF Department Rural and Land Reform	Authorisation, rural development programme, Local economic development	2017
	Water resource protection	Manage for sustainability using resource directed measures	Management Class, and associated Reserve and resource quality objectives set for 10 significant WR	DWA	DEA, CMA's, DAFF,DMR, chamber of Mines, local government,	NSSD, River Health programmes,	2017
	Institutional establishment and governance	Establish robust and sustainable water sector institutions	9 CMA's established, Infrastructure agency, 50% WUA established	DWA, National Treasury	DPSA, Unions, CMF's,CSO's, DAFF	Institutional development, capacity building	2017
	Compliance monitoring and enforcement	Enforce compliance to all legal provisions, quality and quantity standards to ensure efficient WRM	60% green drop compliance, 80% blue drop 100% compliance licence conditions	DWA, CMA's, DEA, DMR,DMR, Water Tribunal	Dept of Justice & Constitutional Development, SAPS, Independent Police Investigative Directorate	Authorisation, Blue Drop, Green Drop, WDCS, WR protection	2017
	Development and operation & maintenance of infrastructure	All water infrastructure is developed in accordance with the requirements of the Reconciliation Strategies and operated and maintained to a high standard and at a capacity required to serve its purpose.	Mobilise capital infrastructure budget allocation for development of new infrastructure as well as for the O&M and rehabilitation of government schemes100% utilisation of allocated budgets for development and O&M	Municipalities, WUAs, Water Boards, TCTA, Infrastructure branch, National Treasury, DCoG, Public Works	Private sector, DBSA, Education, DoH, DAFF, DRALR	RBIG, ACIP, MIG, Green Drop, Transfers, MWIG Investment Framework and funding model	2017

16.4 Communication and roll out of the NWRS2

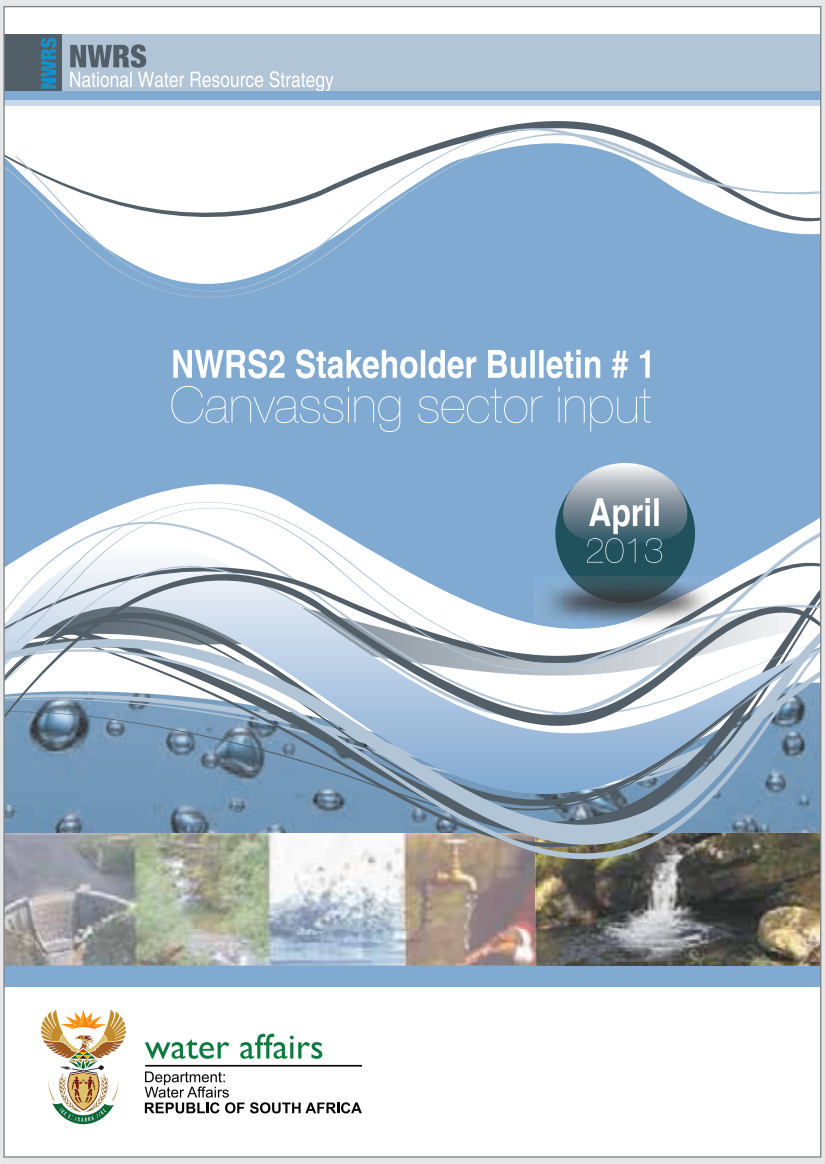
A key thrust of the NWRS2 is to maximise sector stakeholder participation in the implementation of the strategy. It is essential that the NWRS2 is brought the attention of every citizen of South Africa.

Ownership of the NWRS2 by all water users is a critical success factor, which recognises that given the diverse nature of users, a one-size-fits-all approach to communication is not possible. Innovative, cost-effective and targeted rollout and communication activities, built upon lessons learnt from the approach adopted during the development of the Strategy and weaknesses in the implementation of the NWRS1, are envisaged.

These are aimed initially towards catalysing and strengthening implementation planning and, subsequently, operationalisation of NWRS2 Implementation Plans. A dedicated communication and stakeholder engagement focus will be maintained throughout the lifespan of the strategy, aimed at enhancing commitment and co-ordination and promoting knowledge sharing to optimise progress and leverage synergies during implementation.

A mix of media and electronic communication, sector-specific working sessions, bi-lateral engagements, harnessing existing and targeted engagements with prioritised stakeholders will be utilised. For more information visit www.dwa.gov/nwrs12

Particular attention will be paid to reaching out to critical stakeholder groups whose participation requires immediate enhancement, including emerging farmers, municipalities, water user associations, youth formations, training institutions and communities. Reader-friendly communication materials in all official languages are under preparation to facilitate water user engagement with the NWRS2.



DEFINITIONS

Acid rain	Rainfall of abnormally high acidity which results from atmospheric pollution by emissions of sulphur dioxide, nitrogen oxide, and chloride.
Anti-pollution measures	The reduction or elimination of pollution by restricting or prohibiting activities which cause pollution.
Aquifer	Aquifer means a geological formation which has structures or textures that hold water or permit appreciable water movement through them.
Biodiversity	The number and variety of organisms and life forms, including all species, representing the totality of all their genes, found in an ecosystem or in a region.
Biosphere	The global sum of all ecosystems in the zone of life on Earth; integrating all living beings and their relationships. All life forms in the atmosphere, all oceans, freshwater, soils, land surfaces and the underlying geological horizons.
Capable and developmental state	A state that has sufficient human, financial, economic and natural resources to achieve the national objectives for the benefit of all citizens, through effective institutions and infrastructure that enable the economy and society to operate to its full potential.
Catchment	An area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points.
Climate change	Changes in climatic conditions due to natural causes or to anthropogenic (man-made) effects such as emissions of greenhouse gases, e.g. carbon dioxide, nitrous oxide, and methane, from industry, transport, farming and deforestation, that are expected to have significant consequences for rainfall and water availability on earth.
Constituents	Individual components, elements, or biological entities, such as suspended solids or dissolved salts.
Consumption	Use of water abstracted from any source, such as a river, groundwater or water supply system, for domestic, commercial, industrial, power generation, irrigation or any other purpose.
Contaminants	Constituents which are added to a water supply through the use thereof.
Deforestation	Removing natural forests from the landscape for the purpose of harvesting the timber or for making the land available for other purposes.
Democracy	Rule by the people.
Desalination	The removal of unwanted salts (constituents) from water to make it fit for use.
Development	The systematic use of scientific and technical knowledge, together with traditional knowledge systems and cultural values, to realise the potential of natural resources to support social and economic transformation.
Ecosystem	A community of all the organisms, such as plants, animals, fish and microbes, living in complex but balanced relationships with the physical features of their environment such as light, heat, moisture, wind, water, nutrients and minerals.
Efficiency-equity trade off	Seeking the socially, economically and politically most acceptable outcome of decision-making concerning the competing merits of efficiency and of equity and fairness.
Effluent	The liquid discharged from a processing step, usually from an industry, from a water purification works or from a waste water treatment plant.
Effluent discharge Standards	Minimum standards set for the quality of effluent streams as a means of controlling externalities, i.e. the economic and other effects on others.
Efficient water allocation	A situation in which the available water resources are allocated in a way that achieves maximum benefit.
Emissions	Solid, liquid or gaseous substances, or energy in the form of heat, usually discharged into the environment, by people and other living organisms or by chemical or physical processes; usually refers to products of combustion emitted into the atmosphere.

Environmental engineering	The application of science and technology to minimise the negative and to maximise the positive impacts on the environment of physical development and of the utilization of natural resources for the benefit of society.
Environmental protection	Avoiding negative impacts on the environment caused by physical activities, by the discharge of harmful solid, liquid or gaseous wastes or by the release of radiation.
Equity	Fairness, justice and impartiality which supplements or overrides common and statute law.
Hydraulic fracturing	Consequences of an action, usually negative but could be positive, which affect other parties but are not reflected in the costs.
Externalities	Also known as fracking. It is the process of injecting pressurised fluids into various rock layers in order to create cracks to allow natural gas to move freely.
Fog harvesting	The interception and precipitation of moisture in fog to form water.
Governance	Action or manner of governing by implementing sound rules and procedures.
Global warming	The increase in the average surface temperatures across the globe, usually measured over long periods of time; reported to have increased by 1^{0}C over the past hundred years.
Government	This refers to the total of all levels of government, including national, provincial, and local government as in South Africa. It is always necessary to check what level of government is being referred to in any particular context.
Greenhouse gas	Gases such as water vapour, carbon dioxide and methane in the atmosphere that do not affect incoming sunlight but trap heat emitted from the Earth, thus contributing to global warming; hence the greenhouse effect.
Green water footprint	The volume of water evaporated from rainfall stored in the soil as soil moisture.
Grey water footprint	The volume of freshwater required to assimilate a pollution load to at least comply with acceptable water quality standards.
Groundwater	Rainfall that infiltrates into the soil surface and percolates downwards, seepage from water in streams, lakes and artificial impoundments, and irrigation water that percolates down into the ground and accumulates in aquifers comprising permeable underground layers of sand, gravel and rock.
Growth	An increase in an economic factor or variable, normally persisting over successive periods. Rapid or persistent growth is likely to involve changes in the nature of economic activity, with new products or processes, and new types of labour skills, capital goods, and economic conditions.
Impurities	Constituents which are added to the water supply through use.
Management	The people who make decisions in an organization; the effect, impact and outcome of these decisions.
Mandate	Authority to carry out a policy, course of action or legal command from a superior.
Pollutants	Constituents which are added to water through use.
Pollution control	Methods for controlling pollution, usually by monitoring against minimum standards and acting against contraventions.
Potable	Water intended to be used for drinking or domestic purposes.
Private sector	Those parts of the economy not run by the government, including households, voluntary associations, community organizations, sole traders, partnerships, and privately owned company.
Property rights	The rights of an owner over property.
Public sector	Those parts of the economy which are not controlled by individuals, voluntary organizations, or privately owned companies.

Rain water harvesting	Interception, collection and storage of water during rain seasons for use in other times.
Reclamation	Treatment of wastewater for reuse, including indirectly or directly as potable water.
Recycling	The re-use of wastewater, with or without various degrees of treatment.
Regulation	A rule or directive made and implemented by an authority, which individuals or organizations are obliged to respect and comply with.
Regulatory agency	A body created to decide on and enforce regulations or rules.
Research and development	The use of resources to create new knowledge, and to develop new and improved products or processes, to enhance economic activities and the quality of life.
Repurification	Treatment of wastewater to a quality standard suitable for various uses, including for indirect or direct reuse as potable water.
Re-use	Utilisation of treated or untreated wastewater for a process other than the one that generated it, i.e. it involves a change of user. For instance, the re-use of municipal wastewater for agricultural irrigation. Water re-use can be direct or indirect, intentional or unintentional, planned or unplanned, local, regional or national in terms of location, scale and significance. Water re-use may involve various kinds of treatment (or not) and the reclaimed water may be used for a variety of purposes.
Rights based approach	Priority given to the allocation of water to people who do not have access to water, even to satisfy their basic human needs which is a constitutionally entrenched right; individuals and communities are given access to full information, justice, and to participation in decision-making processes concerning water-related issues. Such water allocations enjoy priority over other uses such as for irrigated agriculture and for industrial use.
Right to access to water	Every person in South Africa is entitled to sufficient, acceptable, safe, physically accessible and affordable water for personal and domestic uses.
River pollution	The effects on rivers of the discharge or dumping into the environment of industrial, agricultural and any other waste products.
Runoff	The portion of rainfall on land or on any other surface that drains away to accumulate in a stream or a river, and which does not infiltrate into the surface, get intercepted by vegetation and other covers where it is stored, or evaporate back into the atmosphere. Runoff is also fed by groundwater which moves naturally into streams and rivers.
Sanitation services	The collection, removal, disposal or treatment of human excreta and domestic wastewater, and the collection, treatment and disposal of industrial wastewater. This includes all the organisational arrangements necessary to ensure the provision of sanitation services including, amongst others, appropriate health, hygiene and sanitation-related awareness, the measurement of the quantity and quality of discharges where appropriate, and the associated billing, collection of revenue and consumer care. Water services authorities have a right but not an obligation to accept industrial wastewater from industries within their area of jurisdiction.
Sand mining	The removal of sand (mainly from river beds and banks) for commercial purposes; including the screening and washing of fine material out of the product.
Sewage	Liquid waste, with some suspended material, mainly human excrement.
Sewage disposal	The discharge of liquid waste from human occupation to the environment, usually after some of full treatment.
Sewerage	Infrastructure for the collection, treatment, and disposal of liquid waste (sewage).
Sludge	Solids removed from wastewater during treatment.
Storm water	Runoff from a built-up area after heavy rain.
Surface water	Runoff that occurs in streams and rivers, also in natural lakes and reservoirs; a major resource for water supplies.

Virtual water	The volume of water required to produce products which a country imports and exports; the volume of water embedded in products that are traded between countries or regions. Most relevant to arid or semi-arid countries with scarce water resources.
Value Engineering	A systematic method to improve the value of infrastructure or services by either improving the function or reducing the cost. It is a primary tenet of value engineering that basic functions must be preserved and may not be reduced as a consequence of pursuing value improvements. (Value is defined as the ratio of function to cost.)
Wastewater treatment	This includes any process which may be used to favourably modify the characteristics of the wastewater.
Water balance	The regulation or rationalisation of human activity to match the sustainable local water supply, rather than base, or a process of balancing water supply and demand to ensure that water use does not exceed supply.
Water efficiency	Getting any given results such as equity, gravity, and development with the smallest possible inputs, or getting the maximum possible output from given resources.
Water footprint	An indicator of water use that considers both direct and indirect water use. The water footprint of a product (good or services) is the volume of fresh water used to produce the product, summed over the various steps of the production chain. Water footprint includes 3 components: • Volume of water as consumptive use or evaporation of rainwater/stored in soil moisture (green water) • Volume of water as consumptive use or evaporation of water withdrawn from groundwater or surface water (blue water) and • Volume of polluted water, calculated as water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards (grey water).
Water licence	A general authorisation issued by a responsible authority for water use is authorised by a licence under the National Water Act, 1998.
Water neutral	The reducing of the impact of the water consuming activity in making the impact 'water neutral' by simultaneous investment in water conservation measures of other alternatives. Water neutral thereby means that one reduces the water footprint of an activity as much as reasonably possible, and offsets the negative externalities of the remaining water.
Water offsetting	The residual water footprint is offset by making a 'reasonable investment' in establishing or supporting projects that aim at the sustainable and equitable use of water.
Water resource strategy	A plan for dealing with uncertain future circumstances with respect to the availability of clean and sufficient water for domestic and commercial use. This is the set of rules by which the action to be taken depends on the circumstances, including natural events such as climate change and the actions of other people.
Water resource	Water that can be used to contribute to economic activity, including a water course, surface water, estuary and ground water in an aquifer.
Water resources protection	Protection in relation to a water resource, means: a) maintenance of the quality of the water resource to the extent that the water resource may be used in an ecologically sustainable way; b) prevention of the degradation of the water resource; and c) rehabilitation of the water resource.
Water risk	Essentially the pressure of decreasing water availability and the reliability of supplies. The fact that the results of any use of water resources are not certain, but may take more than one value.
Water scarcity	Water is scarce relative to human demands, not in and of itself.
Water services	Water supply services and/or sanitation services, or any part thereof.
Water supply services	The abstraction from a water resource, conveyance, treatment, storage and distribution of potable water, water intended to be converted to potable water and water for industrial or other use, to consumers or other water services providers. This includes all the organisational arrangements necessary to ensure the provision of water supply services including, amongst others, appropriate health, hygiene and water-related awareness, the measurement of consumption and the associated billing, collection of revenue and consumer care. Water services authorities have a right but not an obligation to provide industrial water to industries within their area of jurisdiction.
Water trading	The process of buying and selling of water access or use entitlements, also called water rights. The terms of the trade can be either permanent or temporary, depending on the legal status of the water rights.
Wetland	Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

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AgriSA
Bomvu Paradise
Business Unity South Africa (BUSA)
Centre for Environmental Rights (CER)
Chamber of Mines
Chemical & Allied Industries' Association (CAIA)
Council for Scientific and Industrial Research (CSIR)
Dargle Conservancy
du Toit, H (Mr)
Duzi-uMngeni Conservation Trust (DUCT)
EcoDoc & Geasphere
Energy Intensive Users Group (EIUG) of Southern Africa
Eskom
Environmental Monitoring Group (EMG)
Federation for a Sustainable Environment (FSE)
Gauteng Water Caucus
Goodman, M (Mr) General Manager: The Fruitspot
Greenpeace Africa
Harrison, J (Mr)
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Little, I (Mr): Endangered Wildlife Trust
Mallory, SJL (Mr): Institute for Water Research
Mesh Concepts
Motshegoa, D (Mr)
Munnik, V (Mr)
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National Education Health and Allied Workers Union (NEHAWU)
National Planning Commission (NPC)
National Water Advisory Committee (NWAC)
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South African Institute of Civil Engineering (SAICE)
South African Local Government Association (SALGA)
South African Water Caucus (SAWC)
Southern African Faith Communities' Environment Institute (SAFCEI)
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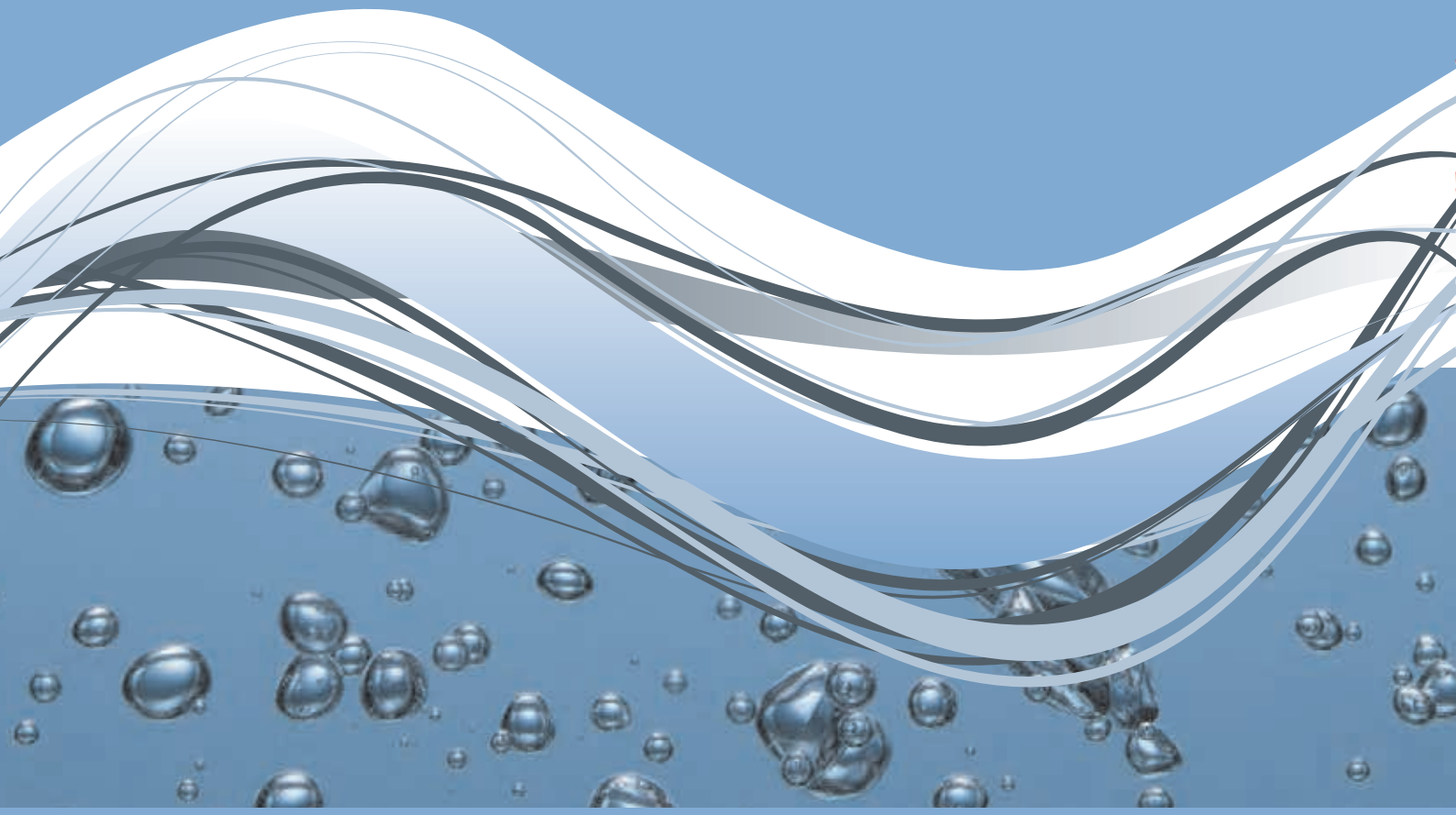
Annexure A

Perspectives per Water Management Area



ANNEXURE A
PERSPECTIVES PER WATER MANAGEMENT AREA

1 Vaal Water Management Area

Comprising the original Upper Vaal, Middle Vaal, and Lower Vaal WMAs.

The Vaal River system supplies the water resource needs of 60% of the national economy and serves 20 million people. This is the economic heartland of South Africa; water resources are limited and must be secure. The Vaal River System is linked to all of its adjacent WMAs, and planning ensures that water will be made available into the long term.

Area of supply

The area supplied stretches well beyond the catchment boundaries of the Vaal River and hence the WMA. There are parts of the WMA that are self-sufficient in water and not supplied directly by the system; all, however, are part of system resource use. The Vaal River System has been integrated into the water resources of the Crocodile West, the Orange, the Thukela, Olifants and Usuthu rivers. System supply reaches most of Gauteng, Eskom's power stations and Sasol's petro-chemical plants on the Eastern Mpumalanga Highveld, the North West and Free State goldfields around Klerksdorp and Welkom respectively, the North West platinum and chrome mines around Rustenburg, iron and manganese mines in the Northern Cape, Kimberley, several small towns along the main course of the river, as well as several large irrigation schemes.

Vaal River system reconciliation

The water resources of the Vaal River catchment are handled almost entirely within the Vaal River System Large Bulk Water Supply Reconciliation Strategy (2009), and the complexities of the water resource situation are not described in detail here. Key points are highlighted:

- All water resources within the catchment are fully used and no further development of any of the tributaries can be contemplated.
- The Upper Vaal River, with Eskom and Sasol the dominant water users, is now in balance given the recently completed 115 km pipeline, with a capacity of 160 million m^3/a, from Vaal Dam to a distribution structure at Knoppiesfontein, near Secunda. It is unlikely that new power stations will be constructed on the Highveld, but existing stations may be refurbished and used for longer than previously planned, with coal imported from the Waterberg coalfields. Some of these power stations will ultimately be closed down and water used by them should then become available, but this cannot be quantified, or planned for, at the current time. Coalmines in the Upper Vaal catchment generally have a problem of too much water (infiltrating groundwater) and have to de-water. These mines do not place additional supply demands on the Vaal System, although they can, and do, compromise water quality.
- The economy of the Vaal River catchment, and much of South Africa, has been built on mining for over 130 years. One consequence has been the growing problem of acid mine drainage[1], particularly in Gauteng. While this could not be foreseen until relatively recently, this is a consequence that must be avoided as new mines continue to be developed, with coal mining in Mpumalanga (Upper Vaal) the most serious future risk to water quality.
- The Vaal Gamagara scheme, abstracting water from the Vaal River just below the Harts River confluence, has a main pipeline distribution network of 370 km, taking water as far as Black Rock in the Kalahari. This scheme is of great importance to the Northern Cape, supplying domestic, industrial and mining water. Transfer of water to Botswana is also being investigated.
- From a study on the ecological Reserve currently being finalised for the Vaal River it has been determined that, for the most part, both the main stem and its tributaries get sufficient water; sometimes too much.

It is important to recognise that water in the Vaal River catchment may be re-used several times, with water used high up in the system (Upper Vaal catchment) cascaded down through the Middle and Lower Vaal regions and ultimately into the Orange River as return flow. Water quality does deteriorate but is managed by dilution. One implication of the downstream dependence on upstream return flows is that volumes will diminish with increased re-use and other water use efficiencies. This must be considered where allocated available water downstream includes significant return flow volumes.

Water resource strategies for the Vaal WMA

Key water resource strategies in the Vaal Catchment are:

- The elimination of unlawful water use
- The implementation of water conservation and water demand management
- The treatment and re-use of mine water as well as sewage effluent return flows
- Implement surface water options
- The use of groundwater
- Implement the Vaal River Integrated Water Quality Management Strategy
- Review the use of water for irrigation and allow for movement of this water towards other sectors

(i) The elimination of unlawful water use: Unlawful water use is a major issue in the Vaal WMA. Validation and Verification[2] has progressed very well and the necessary legal steps are being taken to bring this water back into the system. Control will always be required.

(ii) The implementation of water conservation and water demand management: Saving water is essential if water resource reconciliation is to be achieved in the Vaal System. All municipalities must take WCWDM seriously and all parties and institutions must engage in this. WCWDM is being addressed in the Gauteng Province through the implementation of "Project 15%", with the target of cutting water losses by 15%. An important step, and unique to Gauteng, is the setting up of a Project Management Unit (PMU) covering all the metropolitan municipalities.

[1]Note that the problem is one of acidity and salinity

[2]Validation: Assessing the volume of registered water vs. actual (1998) water use. Verification: Determining the lawfulness of the water use (as it would have been lawful in 1998).

(iii) The treatment and re-use of mine water: The immediate advantages of water treatment are:

a) The acid mine drainage problem is resolved
b) Water is made available for use - close to the source of requirement
c) The quality of the water in the receiving rivers is improved, which also means that smaller releases from the Vaal Dam are required for dilution, and
d) The cost of the reclaimed water is also unlikely to be higher than that of water secured through the next most feasible development option.

Since the commencement of mining in the 1880s, water has been pumped from the underground workings into the Vaal River system to permit work to continue. By the early 1980s the levels of salts from this discharged mine drainage, added to the growing burden from domestic sources, became too high and fresh water from the Vaal Dam has been used for blending and dilution to bring the river back to an acceptable quality. Large scale closure of mines in the Witwatersrand began in the 1970s and deep mining in the Western Basin halted in 1997, reducing the volumes of pumped mine water effluent into the Crocodile River. The impact on water quality in the Crocodile River lessened until these mines started decanting in 2002. As a short-term solution the addition of lime can quickly neutralise the acidity in the water, and some heavy metals can be removed, but this does not reduce the salinity, and this is what most urgently needs to be addressed. The long-term plan is to build the capacity to desalinate mine water decant by 2014/15, and to use this water for domestic and industrial purposes[3].

Mines in the Central and Eastern Basin (inter alia Grootvlei) have also ceased pumping – and this water will also need to be desalinated and made available for re-use.

(iv) Surface water options: Phase 2 of the Lesotho Highlands Water Project (LHWP - Polihali Dam) is currently being implemented and will deliver water by 2020. Further supply from surface resources should only be required after 2035, with additional augmentation possible from either the Thukela or Orange Rivers but at sharply rising cost. The required additional water needs to be held in reserve in both of these systems.

(v) The use of groundwater: Groundwater is a key development option for smaller towns in the Vaal WMA, especially across the dry Northern Cape. Accessible groundwater should always be utilised, even where surface water is available, in order to reduce the demand on surface supplies. Conjunctive use is often the sensible approach. The reduction in surface water use reduces the need to import very costly, and sometimes very scarce, additional supplies. Local groundwater is almost always a cheaper source than new imports of surface water.

Many towns in the Northern Cape rely on dolomitic groundwater as their main source of water. So too, many rural communities in the area rely solely on groundwater for their everyday domestic and agricultural water supply needs. Mining expansion programmes planned in the Northern Cape are dependent on water being available both for mining and for related increased demands for domestic water supply. Current water supplies consist of local groundwater resources (boreholes and mine de-watering), and bulk water supplies from the Vaal-Gamagara (VGG) Pipeline Scheme. The recently completed feasibility study to augment/upgrade the VGG pipeline supply capacity to meet increased water demands has indicated that the success of this endeavour is dependent on the extent to which existing and newly identified groundwater resources can be integrated into the upgrade.

(vi) Implement the Vaal River Integrated Water Quality Management Plan Strategy: The Vaal Integrated Water Quality Management Plan Study (2009), noted that all users - domestic, industrial and mining - contribute to the complex water quality issues.

Managing water quality is therefore a joint responsibility in the Vaal Catchment. The salinity problem has been shown to have the biggest impact on the future security of water in the Vaal River System, and the Strategy highlights this by promoting the treatment and re-use of both mine and domestic sewage effluent.

In addition to salinity problems, there are other water quality issues such as nutrient enrichment resulting in eutrophication, and microbiological contamination from untreated effluent causing health problems. Resource Water Quality Objectives (RWQOs) were set as part of the Integrated Water Quality Management Plan for the Vaal River. These set a high standard for water quality but a strategy on how to manage and limit the impacts of mining, with precautionary actions for new developments, must be developed and implemented without any delay if the ecological functioning of the Vaal River System is to be maintained. If these many issues are not addressed, deteriorating quality will diminish the utilisable volume of water in the Vaal System.

(vii) The use of water for irrigation: The cost of transferred water has become unaffordable for irrigation and no additional water has been allocated to this sector since the first large transfer schemes from the Thukela in the early 1970s. Water to redress inequities will now have to come from savings from existing irrigation allocations. Furthermore, as transfers become even more expensive in future it may become necessary to move some of the existing irrigation allocations into urban use. This issue is not being actively pursued at present.

The ecological Reserve

The biggest issue regarding the ecological Reserve is one of unseasonal over-supply; about which not much can be done. This is for example, the case downstream of Vaal Dam. So too, the Ash and Liebenbergsvlei rivers get constant high level flows from the Lesotho Highlands Water Project (LHWP). Negotiations with Lesotho are aimed at bringing some variation into the transfers once the second phase of the LHWP starts delivering water. Under certain operational conditions, the Wilge River receives large releases from Sterkfontein Dam during the winter months. The possibility of changing the operating rule to mitigate this is being investigated.

2 Orange Water Management Area

Comprising the original Upper Orange and Lower Orange WMAs and the Upper Molopo, which was part of the Crocodile West and Marico WMA.

The Orange River is the country's major artery and a resource that must be managed with great care. The available yield for this system has been fully allocated, and there is no prospect of additional water for allocation without storage volumes being increased. This will come at significant cost.

[3]The technology to desalinate polluted mine water can allow for the constituent salts to be separated out for commercial use; only a small amount of sludge is produced, and this can be contained in slimes dams.

The current water balance in the Orange River
The Orange River is a major resource, with a number of big dams capturing and storing a large volume of water for use. The use of this water includes:

- Transfers from the Senqu to the Vaal River and Gauteng through the Lesotho Highlands Water Project (LHWP)
- Transfers to the Eastern Cape (the Fish-Sundays scheme, with 50 000 ha under irrigation, and onwards as far as the Nelson Mandela Bay Municipality)
- Mangaung and some mines and small towns along the river
- Major irrigation schemes along the river (~112 000 hectares)
- Water for the irrigation of 12 000 hectares of land by resource poor farmers. This was set aside in 1998, although very little of this water has been taken up
- As an international (shared) river the needs of South Africa's neighbours must be accommodated

The current water balance calculation takes account of the future needs of Mangaung (Bloemfontein), the additional water that will soon be needed by the Nelson Mandela Bay Municipality (NMBM), and the water needed to irrigate the 12 000 ha for resource poor farmers - if and when this is taken up.

Some important elements in the current situation include:

(i) The Lesotho Highlands Water Project Phase 2: Phase 2 of the Lesotho Highlands Water Project, construction of the 2 200 million m^3 Polihali Dam and linking tunnel to Katse Dam, is set to commence in 2012 with completion in 2020. From this dam it will be possible to supply a total of 15 m^3/s (475 million m^3/a), with 8 m^3/s (250 million m^3/a) available to the Vaal River and Gauteng. Additional storage in the Orange River will be required to allow the additional 7 m^3/s (225 million m^3/a) to be transferred. Until this is created, the yield in Gariep Dam is effectively reduced and shifted upstream to Polihali Dam and water will have to be released from Polihali Dam to maintain the yield for users downstream of Gariep Dam.

(ii) Supplying Mangaung (Bloemfontein): Mangaung (Bloemfontein) is the only city situated within the WMA, and sufficient water from the Orange River system has been reserved to meet its requirements. A water resource reconciliation study for the Mangaung Metropolitan Municipality has recently been undertaken . With the Welbedacht Dam in the Caledon River (a major tributary of the Orange) having lost much of its capacity through siltation, Mangaung (Bloemfontein) is now supplied with about a third of its water via the Knellpoort Dam, an off-channel storage facility with water pumped from the Caledon River.

Pumping capacity to Knellpoort can be increased, so that a new dam is not necessary. The siltation problem in Welbedacht Dam will also have to be addressed to sustain any long term intervention

(iii) The ecological Reserve: Whilst the Orange River is considered to be 'in balance', the ecological Reserve is not being fully met.

A perspective on the future: There is still more water potentially available out of the Orange River, but this requires significant additional storage infrastructure. The perspective in the NWRS of 2004 was that the Vaal River System, supplying the economic heart of South Africa, relies on this water - and that this must be reserved to meet needs as these unfold. This perspective is maintained in this version of the NWRS and will guide the Orange River Reconciliation Study, which the Department is about to engage on, as discussed below.

Orange River Reconciliation Study
A detailed water resource reconciliation study for the Orange River system commenced in 2012. This will reassess all possible future demands that could reasonably be supplied from the Orange River, and the ultimate yield potential of the system through the addition of various options, but with full consideration of the ecological requirements and international obligations. Recommendations will then be made about the utilisation of this strategic resource. Some of the current thinking is presented here:

Storage options in the Orange River: The most suitable option for added storage appears at present to be the construction of the Boskraai Dam (potential capacity 8 000 million m3/a) at the confluence of the Orange and Kraai rivers near Aliwal North. This dam would help in providing for the ecological Reserve, and would mean a much higher utilisation of all Orange River water. The Reconciliation Study will need to confirm that there is indeed enough water in the system to justify a dam this large, and to plan for the future use of this water.

Groundwater to meet town and mining requirements: There is a transfer from the Henkries pump station on the Orange River to Springbok (130 km) and to the West Coast mines (Kleinzee 120 km). The transfer pipeline, built in the 1970's, urgently needs replacing, and work has already started in this regard, taking into consideration possible groundwater resources available to meet these needs.

Most Northern Cape towns and mining enterprises within the Orange River WMA are dependent on groundwater. There are problems with the natural quality of the water, especially with high salinity, but new desalination technologies make the use of this groundwater much more feasible and small-scale desalination plants can make this water acceptable for use.

Water for solar energy generation: Water for power generation is a national strategic requirement that must be provided for. Solar thermal power plants require significant volumes of water for cooling, of a similar order to that required by a coal-fired station. With solar power stations logically located in the Northern Cape, water will have to be provided if needed but, as with new power stations elsewhere inland, cooling will have make use of "dry-cooling" technology. If this water is required before new yield is created through the building of dams (LHWP's Polihali Dam, in 2020) water may have to be moved from unutilised allocations, or traded from existing users.

However photovoltaic solar power generation requires very little water and the introduction of this technology, as it continues to improve, would decrease the demand for water for power generation in this area.

[4]Development of Reconciliation Strategies for Large Bulk Water Supply Systems: Greater Bloemfontein Area

The Orange as international river
South Africa is the major user of the Orange River and has invested heavily in developing the water resources of the basin. The Katse and Mohale dams have been built as part of the Lesotho Highlands Water Project and the Polihali Dam is to be built over the period 2012 to 2020. The Gariep and Vanderkloof dams dominate the upper Orange River in South Africa.

The Orange-Senqu Commission (ORASECOM), established in year 2000, provides the four sharing countries (Lesotho, South Africa, Botswana, Namibia) with the opportunity for cooperation on basin-wide issues. There is, for example, a monitoring programme and early warning system aimed at detecting change to aspects such as water quality. Lesotho is developing the Lesotho Lowlands Water Supply Scheme. Namibia has irrigation schemes in the Fish River, some irrigation along the north bank of the Orange, and has indicated its intention to increase this. South Africa and Namibia are investigating the feasibility of a dam at Vioolsdrif, which would deliver water to Namibia and help in the management of South Africa's water use by storing the river's water for the second time (ie after release from Gariep/ Vanderkloof dams), closer to downstream users.

2 Limpopo Water Management Area

Comprising the original Crocodile West and Marico WMA (but excluding the Upper Molopo), the original Limpopo WMA, and the Luvuvhu catchment (previously part of the Luvuvhu/Letaba WMA)

This is a large and complex Water Management Area. Much of the area has a low rainfall and there are significant inter-dependencies for water resources between catchments and with neighbouring WMAs. This discussion offers a situation assessment for each of the many independent catchments, from west to east, feeding into the Limpopo main stem.

The Marico catchment
The Marico River catchment borders Botswana to the northwest and the Vaal WMA to the south. In the east the Marico River joins the Crocodile West River to form the Limpopo River. The catchment is a large, relatively flat basin with a low rainfall. There are no upstream mountain catchments and surface water is limited. The watershed shared with the Middle Vaal region is dolomitic and groundwater is important, with springs, or eyes, providing river base flows. These groundwater catchments are not clearly defined and are partially shared with the surface water catchments of the Middle Vaal.

The Marico is a predominantly rural catchment. The main economic activity and major water use is irrigated agriculture. Settlements include the towns of Zeerust and Marico, along with many rural villages. There is some mining activity but this shows little real growth. Growth in the area is primarily in and around Mafikeng which, although situated in the Molopo Catchment, is supplied from dolomitic aquifers in the Marico. The possibility of bringing water from the Vaal system to Mafikeng has been explored but does not appear promising due to the costs involved. Local sources (groundwater) and WCWDM are immediate options for Mafikeng.

Water supply is very limited in the Marico, and sources are over-exploited, with resources fully developed. The system is under severe water stress. Two major storage reservoirs, the Marico Bosveld Dam in the upper catchment and the Molatedi Dam further down-stream, regulate most of the flow in the Marico River. The Molatedi Dam is large but fills very rarely. There are several other dams, including the Klein Maricopoort (supplying Zeerust), Pella, Kromellenboog and Sehujwane dams, with water used for irrigation and domestic use. Smaller farm dams are used for irrigation, stock watering and game farming. The Molatedi Dam also supplies water to Botswana in terms of an international agreement.

There are no opportunities for new dams. A recent review of the hydrology, "Updating of the Hydrology and Yield Analysis of the Marico River Catchment", shows that there is less water in the system than had previously been determined. Yields are therefore lower than were planned for when allocations were made and the system is in deficit. The recalculation of available yield means that there is less water available – and this applies to all users. The DWA has done a Reserve Determination Study for the Marico Catchment. This recommended that the Present Ecological State (PES) be maintained for Marico River. The importance of implementing an ecological Reserve monitoring programme was highlighted. Allocations from the Molatedi Dam total 23 million m^3/a, yet only 15 million m^3 is available. There are also shortages upstream. The obligation to Botswana, calculated on the previous hydrology, will also have to be reduced if the system is to be balanced.

Groundwater is relatively abundant but its use in the dolomitic areas has reached its limits and is impacting on surface water availability. Irrigation using groundwater from the dolomites must be brought under control to ensure sustainable yield. This almost certainly means limiting some users. The hydrological analysis of the catchment has recommended that this area be prioritised for Validation and Verification of use.

Transfers of water into the Marico from other catchments are unaffordable and local solutions will have to be found from amongst the following:

- Water conservation and water demand management
- Removal of alien vegetation in targeted quaternaries
- Validation and Verification of lawful water use, and water use compliance control
- Further groundwater resource development for areas located outside of dolomitic compartments
- The possible use of water currently allocated to irrigation in order to meet priority domestic demands
- The implementation of the operating rules developed for surface water resources
- A reduction in the allocation from Molatedi Dam to Botswana

The Crocodile West catchment
The Crocodile West River catchment is characterised by the sprawling urban and industrial areas of northern Johannesburg and Pretoria, extensive irrigation downstream of Hartbeespoort Dam and large mining developments north of the Magaliesberg. The bulk of the urban water requirements for this area are supplied by Rand Water, with the Vaal River System as source. Substantial volumes of return flows generated in the urban centres enter the Crocodile River, resulting in a surplus of water in the basin. This surplus offers a resource that can be used to support development in the Lephalale area of the Waterberg, in the adjacent Mokolo River catchment. Both the quantity and quality of water in the Crocodile River are a challenge to the requirements for the ecological Reserve.

The existing Reconciliation Strategy for the Crocodile catchment has three main components:

- The Rand Water service area (including the Crocodile catchment south of the Magaliesberg) will continue to be supplied from the Vaal River system
- Areas north of the Magaliesberg will utilise the increasing return flows from treated effluent from the metropolitan area as the future source of water
- The Lephalale area must optimise the utilisation of local resources, but surplus water in the Crocodile River system is available for transfer

With regard to the transfer of water to the Lephalale area, there have been significant planning changes since 2010. Fewer power stations are to be built, and the Sasol coal-to-liquid project has been put on hold. Expected long-term water requirements have dropped from 147 million m^3/a to 49 million m^3/a. Although there will be more mining of coal (with beneficiation requiring water) and other developments, the most immediate local short-term requirements can be met from the Mokolo Dam.

However, assurance of supply to the two major power stations, of great importance to South Africa, can only be achieved with the provision of a back-up supply of water from the Crocodile River system. While the initial planned pipeline capacity will be scaled down, water from the Crocodile River catchment must still be reserved for Lephalale, although the exact quantity and timing of this requirement are not known at present. Provision must be made to supply at least one more power station, as well as for coal mines that may both export coal and supply the Mpumalanga power stations to extend their operational life spans.

Projected future increases in domestic return flows, and the reduction in requirements in the Lephalale area, mean that there will now be a surplus of water in the Crocodile West system, and it is no longer necessary to seek additional effluent transfers into the Crocodile River to make up the previously anticipated deficit.

The focus of the Crocodile West Reconciliation Strategy is to get better estimates of the requirements in the Lephalale area, and to reserve that amount in the Crocodile River catchment. This would come from the available surplus. Only water still in surplus after this can be made available for re-use in Gauteng. Both the Tshwane Metropolitan Municipality and Magalies Water are planning on maximising the re-use of effluent. Careful coordination can ensure that all return flows are beneficially used.

At the present time, with the large volumes of return flows into the Crocodile West, the management of the water quality in system is an obvious priority to ensure usability. Re-use of this water would probably require partial desalination, especially as return flows dominate the total flows in the river, with insufficient fresh water for dilution.

Using groundwater to supply downstream rural areas (i.e. to the north) will provide water of a higher quality, and is likely to be more cost effective than using surface water.

The Matlabas catchment
The Matlabas catchment has limited water resources and no significant dams. The catchment is in deficit but requirements are low. With very little potential for growth, this is not critical. There is some opportunistic irrigation using very low assurance surface water but the most reliable supply is from groundwater, although boreholes are low yielding.

The Mokolo catchment
The Mokolo River is fed by run-off from the Waterberg Mountains with one major dam, the Mokolo Dam, situated in the lower reaches of the river. Irrigation in the Mokolo catchment upstream of the dam has declined over the years due to the shift towards game farming, and this has meant an increase in the yield of the dam. The Mokolo catchment is largely rural, except for the Waterberg coalfields in the vicinity of Lephalale. Here there is huge development potential but growth expectations have been significantly downscaled since 2010 (see also discussion on Lephalale under the Crocodile West catchment). Although fully allocated, the Mokolo Dam can meet the bulk of current need. The one key additional requirement is to provide assurance of supply to the Matimba and Medupi power stations. The only suitable option for this is to bring in water from another source and hence the planning for a pipeline from the Crocodile West system. Design of this pipeline will pay attention to future needs projections.

There is little opportunity for other development of the water resources in this system. It is technically possible to raise the Mokolo Dam but this would bring with it all the downstream and international supply problems associated with the construction of a new dam. Groundwater can supplement the resource supply to Lephalale, and should always be considered in supplying rural communities.

Lephalala catchment
The Lephalala catchment supports a rural farming community, with the middle reaches of the catchment set aside as a nature conservation area. There has been very little development of water resources beyond farm dams and weirs for irrigation. Irrigated agriculture is supported primarily by surface water abstraction in the upper reaches, and through the abstraction of alluvial groundwater in the lower reaches of the catchment.

As a largely unregulated river the Lephalala supplies flood flows to the Limpopo, but even without major dams all low flows are captured and utilised. Construction of a large dam is not practical, and local needs will have to be met, as in the past, from local resources and from groundwater.

Mokgalakwena catchment
The water resource in the Mokgalakwena catchment has been fully developed. There are two significant dams, the Doorndraai Dam (supplying Mookgophong and Mokopane) and the Glen Alpine Dam, supplying downstream irrigation needs. Water allocated to emerging farmers from Glen Alpine Dam has not yet been taken up and should now be utilised in supplying growing domestic requirements. Modimolle gets its water from the Roodeplaat Dam in the Crocodile West catchment. The Nylsvley wetland is upstream in the Mokgalakwena catchment – a valuable conservation area and source of water to downstream users.

Mokopane is the centre of mining activity and now requires additional water. While the Doorndraai Dam was used for irrigation a big portion of that scheme has already been taken up by Mokopane. The area has gained economic importance due to the rapid expansion of mining and more water will now have to be transferred in to support this as a matter of priority. New mines will be supplied from the Flag Boshielo Dam in the Olifants River (see discussion on the Olifants River Water Supply System).

With the exception of Mokopane and transfers of water to meet the needs of the upper reaches of the Mokgalakwena, the catchment will have to rely on its own resources.

The Sand catchment
The Sand River is aptly named. The catchment has limited surface water and is heavily dependent on transfers from neighbouring systems. It does, however, have good groundwater reserves although these have been fully- and possibly over-exploited.

Polokwane Local Municipality, in the upper catchment, is reliant on water from the Letaba River (Ebenezer and Dap Naude dams), and from the Olifants River (Flag Boshielo Dam), together with local groundwater resources. Polokwane also recycles effluent water though an innovative artificial recharge scheme. Polokwane is a growing city and will require more water from the Olifants River in future.

Louis Trichardt and environs (Makhado Local Municipality) draws on the Albasini Dam in the Luvuvhu catchment, and will in future take water from Nandoni Dam, also in the Luvuvhu. The town recycles effluent for urban irrigation; this will increase as a resource and will have to be considered for industrial and even domestic use in the future.

Louis Trichardt and environs (Makhado Local Municipality) draws on the Albasini Dam in the Luvuvhu catchment, and will in future take water from Nandoni Dam, also in the Luvuvhu. The town recycles effluent for urban irrigation; this will increase as a resource and will have to be considered for industrial and even domestic use in the future. Groundwater is also important.

There are large groundwater irrigation areas, such as around Dendron and Vivo, in the central and northern Sand catchment. The challenge for these schemes is sustainable use, and farmers need to work this out together. Communities are also groundwater dependent but there does not seem to be conflict with agriculture in the use of aquifers.

Game farming predominates in the north of the catchment, in which the Mapungubwe National Park is also situated. There is no surface water and no large-scale irrigation. Coal mining potential in the vicinity of Louis Trichardt and Musina will only be realised if water can be leveraged from local sources – either through groundwater or by shifting agricultural water use into the mining sector.

The Nzhelele catchment
The Nzhelele is a rural catchment draining northwards into the Limpopo. The catchment economy is dominated by irrigation, with some forestry on the slopes of the Soutpansberg Mountains. There is a small industrial area known as the Makhado Centre. The catchment is regulated by two dams, the Nzhelele Dam and the much smaller Mutshedzi Dam, used for irrigation and domestic supply. Groundwater sources are suitable to meet the needs of all villages. The catchment is stressed even without implementation of the Reserve. Both dams could technically be raised to increase capacity but this would be very difficult to justify in the face of international obligations. Some of the allocated irrigation water has also not yet been taken up. Further to this there are very significant losses of water, especially from the Nzhelele Canal system. Validation and Verification of water use is to be undertaken as a first step in seeking to balance water availability with requirements. Water use efficiency measures have to be implemented, after which a reduction of existing allocations is the only reasonable measure to achieve this balance.

There is potential for coal mining in the middle and upper reaches of the catchment. This will require that water be found locally – either groundwater or existing agricultural water. The transfer of effluent water from Louis Trichardt is not supported by DWA as this water could otherwise be used by the town, and its use elsewhere would effectively mean that a transfer from Nandoni Dam to Louis Trichardt would be required. All the available water in Nandoni Dam is needed to supply demands in the Luvuvhu catchment, as well as parts of the very stressed Middle Letaba.

The Nwanedi catchment
The Nwanedi catchment has some irrigation from two small dams and run-of-river yield. There are also good groundwater resources. The system is over-allocated but, as in the Nzhelele, not all allocations are being put to use.

The approach in both the Nzhelele and the Nwanedi catchments has to be to reduce water use losses, improve efficiencies, and put unused water to work.

The Luvuvhu catchment
The Luvuvhu River, rising off the south-eastern flanks of the Soutpansberg, is one of the only well-watered catchments within the Limpopo WMA. The catchment is now very densely populated. Villages are amalgamating and upgrading and the landscape can be described as a "rural megalopolis". Thohoyandou hosts the District Municipality, and is the regional 'service centre'. The economy is driven by irrigation, along with commercial forestry.

A number of dams have been built in the Luvuvhu catchment and there is no scope for further storage. The Albasini Dam is over-allocated and, along with reductions in canal losses, some curtailment of irrigation may be necessary in order to balance requirements with availability. The most recent new dam is Nandoni Dam, completed in 2005. This was intended, inter alia, to supply regional bulk water to Thohoyandou, Malumulele, and Louis Trichardt. There is still some unallocated water in Nandoni Dam but this will be required for local domestic growth. This water is the last local source and should not be transferred elsewhere without a serious weighing up of the implications. The urgent needs in the Middle Letaba have nevertheless led to the current construction of an emergency water supply scheme from Nandoni for Giyani. In the medium term local water sources in the Giyani area (primarily groundwater) will have to be developed to meet local needs as the Nandoni Dam will be hard-pressed to meet other immediate needs in the Luvuvhu. Groundwater is important in supplementing irrigation downstream of Albasini Dam (conjunctive use), and in providing water to rural communities in the vicinity of Thohoyandou. The control of invasive alien vegetation is also important in this catchment.

The Mutale River joins the Luvuvhu from the north, just above the Pafuri floodplains, from where it flows into the Limpopo before this enters Mozambique. The Mutale River is largely unregulated and still in a relatively natural state. The NFEPA[5] Report recommends strongly that it be maintained as a natural system. Any development of the river would also have to be negotiated internationally.

A Reconciliation Strategy Study for the Luvuvhu and Letaba Water Supply System, aimed at finding the best utilisation of water resources, has been commissioned by the DWA.

The Limpopo main stem
The Limpopo River once flowed perennially but is now highly seasonal. The main stem supplies a narrow agricultural strip and some mining activity. Weirs across the upper reaches of the river are used to store some water, while further downstream water is drawn from large sand aquifers in and next to the riverbed. Both the Venetia diamond mine and the town of Musina are supplied by alluvial sand aquifers. Main stem water resources are fully developed and any expansion or new development will have to get its water from other existing sources – typically by buying out irrigation water.

The ecological Reserve in the Limpopo catchment
Development in these catchments started over a hundred years ago and flow in the tributaries of the Limpopo River has greatly diminished. When farmers on the Limpopo main stem finally got electricity, pumping directly from the river increased significantly. Flows became intermittent and weirs were built across the riverbed, especially in reaches above the confluence with the Shashe River. Water was, and is, pumped from these weirs, which have no control structures to release flows. Lower down, water is drawn from the alluvial sand aquifers directly underneath and along the river.

There have been Reserve determinations in the Crocodile West, the Marico and the Mokolo. It is not in any way practical to release upstream flows for the management of low flows in the Limpopo. Water released from the tributaries might reach the main stem but would never get beyond the first weir. The low-flow status quo of the Limpopo main stem has changed irreparably, and a true Reserve can now never be achieved. Botswana does not have legal obligations to the Reserve of this common river, complicating the task. It is nevertheless recommended in the NFEPA report that a portion of the Marico River be protected in its current, relatively pristine condition. The Mutale River should also be preserved as a natural system.

4 Olifants Water Management Area

This comprises the original Olifants WMA as defined in the NWRS of 2004, together with the Letaba River system (previously part of the Luvuvhu/Letaba WMA)

This is a highly stressed WMA, fast growing in terms of population and need for improved services. There is very little opportunity for further water resource development and no realistic opportunity to import significant volumes of additional water from elsewhere.

The Letaba and Shingwedzi catchments
The Shingwedzi River, which joins the Olifants downstream in Mozambique, is situated almost entirely in the Kruger National Park. It is of local importance but does not deliver significant sustainable yield to the overall system.

The Letaba River catchment is drained by the Groot Letaba River and its major tributaries - the Klein Letaba, Middle Letaba, Letsitele and Molototsi rivers. The Letaba joins the Olifants River just upstream of the border with Mozambique. The catchment of the Groot Letaba is well watered in the upper parts, where the river rises in the Drakensberg. The Middle Letaba River is a tributary of the Klein Letaba and these rivers are quite different from the Groot Letaba, having very dry catchment areas. Regular water shortages over a number of years have brought about what is commonly known as "the Middle Letaba crisis".

[5] National Freshwater Ecosystem Priority Areas (Water Research Commission 2011)

Major urban areas are Tzaneen and Nkowakowa in the Groot Letaba catchment and Giyani in the Klein Letaba. Tzaneen is built upon commercial agriculture, with a growing base of emerging farmers. Irrigation in the Groot Letaba is supplied primarily via the Tzaneen Dam. Water resources from the Tzaneen Dam have been over-allocated, resulting in high risk to farmers, and the ecological Reserve is not being met. The Groot Letaba River Water Development Project is aimed at resolving these shortages, including the needs of the Reserve. Necessary additional storage opportunities include the raising of Tzaneen Dam and the construction of the Nwamitwa Dam, downstream on the Groot Letaba. Both of these projects are ready for implementation and waiting National Treasury approval.

The Middle Letaba Dam was constructed to meet the needs of both irrigation and the town of Giyani, but the dam is unable to meet the growing domestic need. High water losses are a major contributor to the problem with half of the water never reaching its destination or achieving its intended use. The linking canal from the Middle Letaba River to Ntsami Dam leaks much of this water and repairs must be undertaken. Water losses in the Giyani municipal area are also far too high. Whilst a temporary transfer has been authorised to supply Giyani out of Nandoni dam in the Luvuvhu River, DWA will not change the status of this temporary allocation until both WCWDM and all other sources of water within the catchment have been fully explored and implemented. (As noted in the discussion for the Limpopo WMA, all water from Nandoni dam is required to meet local needs in the Luvuvhu catchment, and everything should be done to ensure that Giyani becomes self-sufficient).

Many high-yielding boreholes have been drilled in the Giyani area but a large number of these are no longer operational. These boreholes should be equipped and linked up to a bulk supply system, with water distributed from central reservoirs to allow for a proper management programme and operational rules. This would offer a sustainable water supply at a high level of assurance. Further groundwater augmentation opportunities should be investigated in all Letaba river catchments. A Reconciliation Strategy Study for the Letaba-Luvuvhu is to be commissioned by DWA.

The Olifants catchment

The water balance situation: The Olifants River originates on the Mpumalanga Highveld, flowing northwards before curving in an easterly direction through the Kruger National Park and into Mozambique where it joins the Limpopo River. Water requirements have increased substantially in recent years, with the mining sector growing particularly rapidly. The system is highly regulated, with the most significant dams being the Witbank, Middelburg, Bronkhorstspruit, Mkhombo, Rust De Winter, Loskop, Flag Boshielo, and Blyderivierspoort dams. Groundwater is also important as a resource. Significant volumes of water are transferred from the Vaal, Usuthu and Komati River Basins to supply power stations located in the Upper Olifants. Available water resources are nevertheless not sufficient to meet the requirements of users and this is one of South Africa's most stressed catchments in terms of both water quantity and water quality.

The ecological Reserve, as defined at present, cannot be met. The ecological requirements are highlighted by the position of the Kruger National Park at the bottom end of the catchment. The Kruger National Park and other wildlife reserves and recreational facilities are important tourist destinations and significant income generators for the country.

Water quality: Water quality problems are serious, often originating from identifiable point sources. The treatment of effluent and mine water is already being implemented in Emalahleni, providing an important source of utilisable water.

Infrastructure development: The De Hoop Dam is currently under construction, mainly aimed at supplying mining and domestic water. However, even with the De Hoop Dam in place the system will still have a large deficit.

The only options for additional dams have been identified low down in the system (Sekukuhuneland and in the Lowveld) but it is highly unlikely that construction will be feasible both from a cost benefit perspective and in view of downstream international obligations. To import water from other catchments (e.g. the Vaal) is technically possible, but would be very expensive.

Reconciliation options for the Olifants: Any new development in the Olifants River Catchment will have to consider resource scarcity and cost. This could well constrain development, particularly in terms of timing.

A Water Resource Reconciliation Strategy Study for the Olifants River catchment is to be completed. From this study it is already apparent that solutions to the water resource shortages within the Olifants catchment will have to come from within, and there is no easy supply option.

Reconciliation options are being evaluated to alleviate the deficit that still remains after the completion of De Hoop Dam. Suggested interventions include:

(i) Implementation of water conservation and water demand management in all sectors (improve operating rules, eradicate unlawful water use, remove invasive alien plants, water use efficiency, etc)
(ii) The use of mine water and treated effluent
(iii) Development of groundwater resources, notably for mining, and
(iv) Water Trading: water saved through agricultural efficiencies could be moved into the mining and industrial sectors.

Options for reconciling the water balance include a re-evaluation of the Reserve requirement. It may be possible to achieve the ecological goals with less water than previously considered necessary. This is currently being investigated as part of the reconciliation study.

5 Inkomati – Usutu Water Management Area

Comprising the original Inkomati WMA and the Usutu River system (excluding the Pongola catchment).

The Inkomati WMA, as defined in the NWA of 1998, has an established catchment management agency (CMA), with a draft Catchment Management Strategy (CMS). This CMS now needs to be amended to represent and meet the needs of the larger revised WMA, which includes the Usutu River catchment.

Transfers of water into this WMA from elsewhere in South Africa are not feasible given distance from all other sources. Opportunities for new dams are very limited, beyond some possible storage to meet growing domestic needs. Water resource deficits will have to be met from within the WMA through more efficient use of the limited resources.
Inkomati-Usutu WMA can be subdivided into four distinct areas:

- *Sand and Sabie River systems*
- *Crocodile River (East)*
- *Komati and Lomati River systems*
- *Usuthu River catchment*

Sand and Sabie systems

Sand River catchment: The Sand River catchment is largely ex-homeland area with large concentrations of people living in a semi-rural context. The Sand River has very little mountain catchment area producing runoff and is generally poorly watered. While there is some groundwater still available for domestic use, all other available water from within the catchment has been used and the area is dependent on transfers from the Inyaka Dam on the Mariti River (Sabie system). Backlogs in domestic supply have not been cleared and the population continues to grow. The ecological Reserve is also not being met, negatively affecting river systems and downstream game reserves, including the Kruger National Park. Water requirements exceed not only the available supply but also the potentially available supply. Water resource reconciliation options for the Sand River catchment include:

(i) Water conservation and water demand management in both the domestic and irrigation sectors.
(ii) There is some potential for water resource infrastructure development but options have both environmental and international implications. The construction of the New Forest Dam on the Mutlumuvi River, aimed only at meeting domestic requirements, could be considered. Any new dam development would have to be negotiated with Mozambique.
(iii) A significant volume of water is allocated to irrigation, but water distribution to schemes like New Forest, Dingleydale and Champagne are in a poor state and the level of inefficiency is high. It will not be possible to justify a new dam, even for domestic use, when so much water is being visibly wasted. Achieving efficiencies and moving some of this water into the domestic sector is an important option.
(iv) The provision of surface water from the Inyaka Dam (completed in 2002) has led to the abandonment of groundwater supply schemes in many villages. However, the conjunctive use of surface and groundwater is essential if all requirements are to be met, and if risks in the failure of supply are to be reduced. Existing groundwater resources must be refurbished and properly operated and maintained, and new groundwater sources developed.

Sabie River catchment: The Sabie River is in a better condition than most river systems in the country. The catchment is in balance, with water availability matching requirements and with the ecological Reserve being supplied. However, there is no water to spare. The Inyaka Dam on the Mariti River was expected to bring about some surplus, but water availability has proved to be just enough to meet existing requirements. Domestic requirements are on the increase and some of the allocations for the currently abandoned irrigation schemes like Calcutta and Lisbon may have to be re-allocated to meet the future needs of the domestic sector. Not all domestic water use abstractions in the Sabie and Sand catchments have been licensed and control over actual requirements and use must be asserted.

Reconciliation options for the Sabie River include:

(i) Water conservation and water demand management in both the domestic and irrigation sectors.
(ii) Allocated but unused irrigation water could be transferred to domestic use. If this approach is adopted then ineffective irrigation schemes should not be refurbished and the uptake of scheme water should not be encouraged; even actively discouraged. Tourism in the Sabie catchment may already be making use of some "irrigation" water (this being a de facto transfer by users themselves).
(iii) Opportunities for the conjunctive use of groundwater must be explored.

The Crocodile River (East)

Water from the Crocodile River has been over-allocated and water requirements regularly exceed available supplies. This is managed largely by users themselves through voluntary water restrictions. The ecological Reserve[6] is not being fully supplied, and it is difficult to meet international obligations.

Existing dams in the Crocodile River catchment cannot capture and control all potentially available water, so in theory there is some potential for additional storage – but dam sites are few and far from ideal, and would be expensive to develop. Any impact of additional storage on South Africa's ability to meet international obligations would also have to be negotiated.

[6]The "use it or lose it" policy has resulted in significant additional uptake – with users trying to secure a right to the resource. Water lost through resultant inefficiencies needs to be recouped.

The Nelspruit/KaNyamazane complex, capital of Mpumalanga, is one of the fastest growing centres in the country. Water management in some areas is very poor and losses extremely high, so whilst the area needs more water this must first come through implementing water conservation and water demand management (WCWDM) measures to reduce losses and wastage. The DWA is embarking on a water resource Reconciliation Strategy for Mbombela. Moving water from irrigation to urban, industrial and domestic use, as well as increased storage will also be examined as options.

The Komati and Lomati river systems

The Komati and Lomati river system is currently in balance owing to the relatively new Driekoppies and Maguga dams. This has been a good example of resource sharing between South Africa and Swaziland. There is however currently no water available for additional use and irrigation water allocations will have to be used to meet domestic water requirements - both to eradicate service backlogs and to meet growth requirements.

The upper Komati remains an important source of water for power generation on the Highveld, with Eskom requiring the full yield from both the Vygeboom and Nooitgedacht dams. This use has strategic priority. Long-term planning was for this water to become available for reallocation with the phasing out of the Highveld power stations as local coal supplies diminish. However, Eskom is now considering the possible importation of coal from Lephalale to keep the power stations in operation for longer than originally intended. The current allocation must therefore be retained for this purpose. The development of any further storage on the Komati River would be very expensive and is not currently considered a viable option.

The Usuthu River catchment

The Usuthu River in South Africa is close to being fully utilised and approximately in balance, with just a small quantity of water still available for domestic use. As in the case of the Komati, much of the available water from the Usuthu catchment (Jericho, Westoe, Heyshope and Morgenstond dams) is transferred out of the catchment for use by Eskom power stations on the Highveld. This requirement is likely to stay in place for the foreseeable future. The upper Usuthu is not a densely populated area and the topography, poor soils, altitude, and distance from markets are a limitation on growth and development. Afforestation is the dominant land use but expansion remains limited by water availability. There is very little irrigation, which also means that there is not much opportunity to trade irrigation water back into domestic or other use.

Low future growth means that it should be possible to maintain the status quo; no major development plans are possible. Swaziland is also very dependent on the Usuthu River, and relies on responsible upstream use by South Africa.

6 KwaZulu-Natal Water Management Area

Comprising the original Usutu-Mhlathuze WMA (excluding the Usuthu Catchment), the Thukela WMA, and the Mvoti-Mzimkulu WMA.

The KwaZulu-Natal (KZN) Water Management Area comprises a number of medium to very large catchments with all the rivers flowing directly into the sea, apart from the Pongola River that joins the Maputo River in Mozambique. There are some water transfers across catchments. The most important sharing of water is the use of the Thukela System to supplement the Vaal System, with more water reserved for expected long-term requirements. The most critical water supply issue in the WMA is in meeting the growing requirements of the KwasZulu-Natal Coastal Metropolitan Area, which includes the eThekwini Municipality (Durban) and its environs. The KZN Coastal Reconciliation Strategy published in 2010, is a key source document. This strategy review considers the situation within each individual catchment in the study footprint area.

The Pongola catchment

The Pongola system is dominated by the massive Pongolapoort Dam (full capacity 2 267 million m^3). The catchment is in balance upstream of the dam, with the Bivane Dam providing irrigation water to sugar cane farmers.

The Pongolapoort Dam still has some available surplus water, all of which has been earmarked for use benefitting the local population. There are a number of considerations associated with the utilisation of water from the Pongolapoort Dam:

(i) The Pongola is a shared river with international obligations.
(ii) A significant volume of water must be released for social and ecological purposes.
(iii) Mozambique is very sensitive to high flows in the Maputo River System. Great care is required when making flood management or ecological/social releases.
(iv) For dam safety reasons involving the capacity of the spillway, the dam must be operated at a reduced full supply level. The provincial road currently routed over the dam wall would have to be re-routed if the dam is to be utilised to its full potential.
(v) Schemes to utilise available water have not been successful, including a recent proposed plan involving 40 million m^3 water for irrigation water per year.

There is sufficient water available from Pongolapoort Dam to meet domestic and significant irrigation needs in the area, but this water has not been utilised yet. Even with the reduced full supply level there is still some 50 million m^3/a available for use.

The Mkuze
Water in the Mkuze River catchment is very intensely utilised both by forestry and for irrigation purposes. Low flows, particularly, are over-utilised. There is a 32,6 million m^3/a transfer out of the Pongolapoort Dam into the Mkuze catchment for irrigation and domestic purposes. There is no suitable site or opportunity for a large dam on the Mkuze River and therefore little regulation (storage) of the river flow. Upstream water use, poor catchment management, and erosion in the catchment exacerbate the fresh water deficit and other ecological problems experienced by the estuarine Lake St Lucia, a World Heritage Site. However, the fact that no dams have been built does mean that Lake St Lucia still receives the bulk of the floodwaters.

The Mfolozi River
The Mfolozi River catchment has very few dams and is therefore, like the Mkuze, largely unregulated. Suitable in-stream dam sites are few and such dams would have to be very large to accommodate the high silt loads. There are some opportunities for smaller off-channel dams but these would be costly, with water unlikely to be affordable by irrigators. Off-channel storage is an option should the water be required for Richards Bay, situated in the neighbouring Mhlathuze catchment. The proposed re-routing of the Mfolozi River to discharge back into the lower end of Lake St Lucia, as it once did naturally, needs consideration.

The Klipfontein Dam, high upstream in the White Mfolozi River supplies both Abaqulusi Local Municipality (Vryheid) and Ulundi Local Municipality. There are increasing water requirements in both of these towns and one option is to increase yield by raising the wall of the dam. This would be very expensive. While major further surface water infrastructure (storage) development is possible in the Mfolozi, there is not yet a big enough need to justify this.

The hydrology of both the Mfolozi and the Mkuze rivers is poorly known and the first step would be investment in improving this knowledge before any large development projects can be seriously considered.

The Mhlathuze catchment
The available water in the Mhlathuze catchment has been over-allocated to users but the full allocations have not been utilised and the system is therefore rarely subject to restrictions. There is an augmentation transfer out of the Thukela River that is activated when the level in the Goedertrouw Dam drops below a critical level. This provides a high assurance of supply to Richards Bay. The Mhlathuze Catchment has been a pilot for Water Allocation Reform, aimed at bringing about equity in allocations. This should also correct existing over-allocations.

With Richards Bay (uMhlatuze Local Municipality) a strategic and growing economic node, the options required in securing and optimising the use of the water resource is critical and the Department is to undertake a full water resource reconciliation strategy study starting mid-2013.

The Thukela catchment
The Thukela River is the largest river in the KwaZulu-Natal WMA. The river is extensively utilised for transfers into the Vaal System, and also to other catchments both to the north and south in order to support economic growth in KwaZulu-Natal. Existing transfers include:

(i) The Thukela-Vaal transfer scheme - for augmenting the Vaal River system
(ii) Zaaihoek Dam in the Slang River (a tributary of the Buffalo River) - for Eskom power generation on the Highveld
(iii) Transfer to the Mhlathuze for augmenting Richards Bay's industrial water supply
(iv) The Mooi-Mgeni River transfer, currently being increased with the construction of Spring Grove Dam – to supply eThekwini Municipality (a metropolitan municipality)
(v) Construction of the North Coast Pipeline by Umgeni Water to supply water from the Thukela River to the KwaDukuza area will start shortly.

Within the Thukela catchment itself the river supplies water to the Ladysmith and Newcastle complexes, as well as the Sappi pulp mill downstream at Mandeni.

The available water resource as it stands at present (i.e. until further dams are constructed) is close to being fully utilised. There is still potential for building large dams to augment transfers to the Vaal system. Planning for these dams on the Thukela (the proposed Jana and Mielietuin dams) has meant that water from the catchment has been reserved for future augmentation of the Vaal System. Some tributaries are already fully utilised or in deficit including the Little Thukela, the Sundays, and the Mooi rivers. The Buffalo River has a small surplus that could be utilised by Newcastle Local Municipality and surrounds for domestic and industrial use.

Decisions on when additional transfers to the Vaal system will be required from the Thukela River will become clear only with time and a better understanding of the growth in future requirements. In later years, when the Vaal System requires further augmentation, the coastal areas could switch to desalination of seawater or re-use of water, with the stored water in the Thukela transferred to the Vaal System. If further transfers are delayed very far into the future it may become necessary to build a dam somewhere on the Thukela to support supplies to the KwaZulu-Natal coastal metropolitan area together with development along the North Coast.

Mvoti-Mgeni-Mdloti catchments
Water requirements of the KwaZulu-Natal Coastal Metropolitan Area (Durban-Pietermaritzburg and KwaDukuza in the north to Amanzimtoti in the south), are still increasing. These needs have led to the Mgeni System and the smaller Mdloti River being fully developed. These systems are already in deficit and will be augmented primarily with water from the Spring Grove Dam on the Mooi River, to be completed in 2013.

The recently completed Kwazulu-Natal (KZN) Water Reconciliation Strategy gives detailed information on how future water requirements can be accommodated.

Water conservation and water demand management (WCWDM) and the re-use of water are essential strategies for the KwaZulu-Natal Coastal Metropolitan Area. WCWDM is the fastest way to reduce requirements, with almost immediate returns on investment. The re-use of water must be more actively implemented for the eThekwini (Durban) area as return flows are otherwise lost to the sea. Re-use schemes can typically be implemented over three years.

Further sources will have to be found to augment supplies after 2023. The construction of a dam on the Mkomazi is a major option for eThekwini (Durban) and the South Coast, and development of the Mvoti River a significant option for the North Coast area. Seawater desalination may be of particular importance to the KwaZulu-Natal Coastal Metropolitan Area because of very rapid growth and the high economic and environmental cost of additional surface water development.

Mkomazi River
The Mkomazi is one of South Africa's last large free flowing rivers. The river has potential for large-scale water resource development, but a dam would come at a high environmental cost. The Mkomazi River is considered a logical source for the eThekwini metropole but should be carefully compared and costed against desalination of seawater before a decision is taken.

An off-channel dam near the coast would serve to meet Sappi Saiccor's water requirements, along with the needs of other local coastal users.

Mzimkulu catchment
There are no big dams on the Mzimkulu River and existing storage provides for only limited regulation. The system is approximately in balance at present but has deficit hotspots - notably Port Shepstone. Here off-channel storage is being investigated to overcome a periodic urban water supply problem.

A water resource study of the Mzimkulu catchment has been recently completed. This indicates that growth, particularly in the agricultural and forestry sectors, needs further water resource development. There are opportunities for this, but these have yet to be costed. Infrastructure costs may mean that the water provided is unaffordable. The area has been identified for forestry expansion and this should be possible provided the forestry sector build compensatory dams, off-channel, to offset the impact of afforestation on the water resource, especially on low flows. Forestry has the advantage that compensatory dams do not need to be as closely linked spatially to the development scheme, as in the case of agriculture. Great care must be taken in development of the Mzimkulu River, which has been highlighted in the recent NFEPA report as being of high importance for protection from major development. Construction of dams in the upper catchment and in the main stem of the river should thus be avoided.

Summary approach for the KwaZulu-Natal Water Management Area
Water resource planning and management in the KwaZulu-Natal WMA has long been dominated by the relative abundance of surface water. However, as the above situation shows, there is very little water to spare. Most catchments are, at best, in balance and many tributaries are already in deficit. There are more opportunities for the development of storage infrastructure in KwaZulu-Natal than in most other WMAs, but few that appear economically viable.

Water has been reserved for major development in the Thukela catchment, but for transfer to the Vaal System. The KwaZulu-Natal Coastal Metropolitan Area can be supplied through a complex combination of implementing water conservation and water demand management measures, water re-use, developing additional storage both to the north and south, as well as seawater desalination.

Twenty per cent of all the groundwater in South Africa is to be found within the KwaZulu-Natal WMA, yet this resource is underutilised in the region. There must now be significant investment in the exploration and development of its potential, especially in augmenting supplies to villages and smaller towns.

7 Mzimvubu - Tsitsikamma Water Management Area (Eastern Cape Rivers)

Comprising the original Mzimvubu-Keiskamma and Fish-Tsitsikamma WMAs.
The Mzimvubu-Tsitsikamma WMA covers practically the entire Eastern Cape Province and includes a number of very large and vastly different catchments, from the arid Karoo in the west to sub-tropical in the northeast.
The water resource situation is described for:

- *Mzimvubu catchment*
- *Mthatha catchment*
- *Mbashe and Kei catchments*
- *Amatole system (supplying the Buffalo City Metropolitan Municipality)*
- *Albany Coast and the Bushmans River catchment*
- *Fish and Sundays River systems*
- *Kouga, Kromme, Gamtoos and the Algoa Water Supply System*

The Mzimvubu catchment
(This catchment includes the coastal catchments between the Mtamvuna and the Mzimvubu rivers, i.e. the Pondoland area)

Surface water development: The Mzimvubu and Pondoland catchment areas have a relatively high mean annual runoff but the water resource remains largely undeveloped and no large dams have been constructed. The Mzimvubu Development Study was completed in 2010 as part of the quest for new development opportunities. This study identified a number of technically feasible dam sites, some limited potential for irrigation and hydropower development and large dryland agriculture potential. A feasibility study for the Zalu Dam that will supply water to Lusikisiki and environs is nearing completion, while a full feasibility study on a potential large dam for irrigation on one of the major Mzimvubu River tributaries is underway.

There are no large centres of urban/industrial demand within easy reach of the Mzimvubu River that could carry the cost required to build dams for water supply. The prospect of transferring water into the Orange and Vaal catchments has been examined over many years, but, with other plans in place to supply inland water requirements, these transfers will not be needed for a long time to come.

Afforestation and dryland cropping: The Mzimvubu catchment is very suitable for afforestation and this is an effective way of putting water to use. Even a large area under forestry will utilise only a small portion of the available water in the catchment.

Along with afforestation the major development potential in the Mzimvubu catchment lies in dryland (rainfed) cropping - typically dryland maize production - with an estimated potential of 400 000 ha. Both forestry and dryland crop farming are direct forms of rainwater harvesting and the most efficient form of agricultural water use. Forestry and rainfed agriculture are seen as the most effective ways of capitalizing on the relatively abundant water resources of this catchment.

Rainwater harvesting through effective land management, field design and the construction of tanks and small dams is particularly important as a strategy in support of irrigated agriculture in the Mzimvubu catchment. The Mzimvubu River has a very high environmental status (NFEPA Report 2011). The area also has high tourism potential. Responsible forestry, rainfed agricultural development and rainwater harvesting all fit well with environmental and tourism development goals.

Land management: Sedimentation of rivers and dams is a major problem in the region due to wide-spread dispersive soils. Past erosion control works have helped with stabilisation but there is a need for the implementation of innovative land care programmes on a substantive scale. These could include the clearing of invasive alien plants and the introduction of land rehabilitation programmes aimed at providing watershed services by reducing erosion. Such programmes have the potential for large-scale job creation.

Groundwater development: There is a very big need for basic water services within the Mzimvubu catchment. The former Transkei Department of Works sunk boreholes in almost every village. These served well when regularly maintained. Water services authorities have not devoted capacity to borehole management and maintenance, and many boreholes and schemes dependent on well fields have now failed, resulting in a loss of confidence in the security of sustainable water supply. These negative perceptions need to be turned around, as abundant groundwater supplies would still be less expensive to develop and maintain than extensive regional distribution schemes comprising long pipelines and large pump stations, therefore resulting in large pumping heads required to lift the water from the deep ravines to the sparsely populated areas on the high-lying areas.

Water resources to supply water services needs in the Mzimvubu and Pondoland catchments can best be met by giving attention to groundwater abstraction, out of both existing and some additional boreholes, particularly in mid- and downstream catchment areas. In headwater areas where groundwater potential may be low, the topography is less incised and there is sufficient surface water available for small off-channel storage dams to meet local needs.

The Mthatha catchment

Water resource supplies are dominated by the Mthatha Dam, which currently has some unallocated capacity. There are exceptionally high losses of water (~ 50%) in the water distribution system supplying the town of Mthatha and the peri-urban areas (King Sabata Dalindyebo Local municipality). DWA considers the current allocation of water to the town to be more than adequate, and will not increase this allocation until losses have been brought under control through implementing effective WCWDM measures.

Most of the water from the Mhtatha Dam (85 million m^3/a) is currently being used to power Eskom's First and Second Falls hydroelectric schemes. As an alternative to hydropower generation some of this water could be made available for domestic distribution to rural areas. With Eskom planning to phase out the base-load scheme and only supply peaking power, there is a strong possibility that this can be negotiated.

The Mbashe and Kei catchments

The Mbashe River has sufficient water to supply all current requirements for water services. There are a number of dams of significant size, including the Xonxa, Lubisi and Qamata dams. The Ncora Dam on the Black Kei River is used to transfer water from the Kei catchment into the Mbashe catchment for the Collywobbles hydroelectric power station. These dams were originally built to support large-scale irrigation but the irrigation schemes were never fully developed and therefore do not make full use of the water. Although these schemes are currently being revitalised, there is still unused water that has been or could be re-allocated for primary use (i.e. for domestic requirements) to surrounding villages. This primary use is a very small part of the total quantity of stored water available for economic development and use. Existing schemes must be utilised efficiently and optimally before any new water storage infrastructure development is considered[7].

Waterdown Dam is the biggest dam in the Kei catchment and the key water source for Queenstown (Lukhanji Local Municipality), situated 60 km away. The 40-year old pipeline urgently requires refurbishment. The water requirements of users currently supplied from the dam exceed the yield of this dam and additional water is urgently required, with supplies to Queenstown very vulnerable. A water transfer from the Xonxa Dam in the Mbashe catchment has been approved and now only awaits the allocation of government funding for construction to start.

The Kei is a dry catchment, especially the Black Kei – with the area being transitional between the wetter east and the arid western (Karoo) landscapes. The Kei River itself is large as a system, but flows are irregular and intermittent. Most of the Kei catchment (Queenstown excepted), is rural in character and towns and villages can all be supplied from existing schemes if these are properly refurbished and maintained, with augmentation from new boreholes, well fields or small off-channel dams where the run-off is adequate.

[7]The Department of Agriculture is left with only 16 Agricultural Engineers and cannot manage the many schemes left within its care.

Amatole system
The Amatole System supplies water to the Buffalo City Metropolitan Municipality (BCMM), incorporating East London, Mdantsane, King William's Town and Biho. A Water Resource Reconciliation Strategy for the Amatole Bulk Water Supply System was completed in March 2008 and a Strategy Steering Committee subsequently established to monitor implementation and regularly update the Strategy. There are five major dams in the system, ensuring that almost all available local surface water is captured. There is very little potential for new surface water development in the close vicinity of the Buffalo City supply area. Improvements in operations management, some infrastructure upgrades, the implementation of water conservation and water demand management measures, and the re-use of water should be sufficient to allow for short to medium term needs, particularly given the expected low population growth trajectory. Desalination of seawater is another important future water augmentation option.

There are no large-scale surface water sources available to meet the needs of the rural areas, and nor are these required. There is potential for additional groundwater development that, together with some small surface water developments, especially off-channel dams, would be sufficient to supply towns and villages. There is potential for limited additional afforestation in the Kat River catchment. The water resources in the Keiskamma catchment are fully allocated, without water to spare. There is an urgent need to clear both of these catchments of invasive alien plants as a water conservation mechanism and to reinstate some environmental flows.

Albany Coast and the Bushmans River catchment
This area includes Grahamstown (Makana Local Municipality) and a number of coastal resort towns. Rainfall is low, surface water scarce, and coastal towns faced a "water crisis" during the severe drought of 2009/10. Grahamstown's local water supplies are augmented by Orange River water via the Orange-Fish transfer scheme. A seawater desalination plant has been built at Bushmans River Mouth and was recently upgraded. This scheme is now operated by Amatola Water. The feasibility of abstracting and desalinating water from the Lower Fish River, saline due to upstream irrigation run-off and natural salinity, and supplying this to coastal towns, is being investigated. Further development of local groundwater sources, with some desalination where the water quality is poor, rainwater harvesting, and re-use of water are also possible options.

Fish and Sundays River systems
The Fish and Sundays catchments are very dry, with 94% of all currently available water transferred in from the Orange River. The key economic activity has been agriculture, with about 52 000 hectares under irrigation. This is very important in the economy of the Eastern Cape but there are sustainability issues. Irrigating with water transferred from the Orange River has mobilised naturally occurring salts in the soils of the upper Fish and Sundays catchments, resulting in salinity of the rivers downstream. Additional irrigation using Orange River water in the upper Fish and Sundays River catchments will inevitably result in added salinity in existing downstream schemes, damaging and possibly ruining these. Water has been earmarked for 4 000 ha of irrigation for emerging farmers, but this should only be used in the lower reaches of these catchments, for example at Barkly Bridge in the Sundays catchment and Tuyefu in the lower Fish River catchment, because of the risk of increased salinization. The irrigation of feed crops in the upper Fish River at Cradock (Inxuba Yethemba Local Municipality) for the production of biofuels cannot be supported from the country's very scarce water resources.

The upper reaches of the Sundays River is in the Great Karoo, and very dry. Towns mainly rely on groundwater supplies and any new development will also be dependent on groundwater. Rainwater harvesting (RWH) becomes very important, with roof tanks necessary to supplement groundwater supplies, whilst also reducing the dependence on a single resource. Water here is too scarce to consider any further irrigation development. This also applies to the Groot River.

Kouga, Kromme, Gamtoos and Algoa Water supply system
The Algoa Water Supply System provides water to the Nelson Mandela Bay Municipality (NMBM, including Port Elizabeth-Uitenhage-Despatch), the Gamtoos Irrigation Board, and to several smaller towns in the Kouga Local Municipality. A Water Reconciliation Strategy was completed in 2010 and a Strategy Steering Committee established in 2011 to oversee and monitor the implementation of the Strategy. The system receives water from the Kouga, Gamtoos and Kromme catchments, which also support a significant area under irrigation. Despite several dams (the Kouga, Loerie, Churchill, Impofu, and Groendal dams), local sources are still unable to meet the growing water requirements of the area and about 30% of the total available water supply currently comes from the Orange River.

Port Elizabeth-Uitenhage is unusual in South Africa in that the industrial water requirement is a larger proportion of urban water use than in other cities. All of the domestic and industrial effluent that can be recycled for re-use can be taken up by industry, so water does not have to be treated to the standards required for potable domestic purposes.

The Nooitgedagt low-level scheme is being implemented to bring in significant additional Orange River water to the NMBM, and some groundwater is available to Uitenhage. There are some prospects for additional local surface water development - mainly in the Kouga River. Industrial re-use of water can stretch resources a long way and, as a coastal city, desalination is a potential long-term future option for the NMBM. As with all urban complexes, reduction in requirements through effective implementation of water conservation and water demand management (WCWDM) measures is essential and actively supported.

8 Breede and Gouritz Water Management Area

This area comprise the original Breede and Gouritz Water Management Areas

The original Breede WMA has an established and functioning Catchment Management Agency. This will need to be expanded to be representative of the newly defined Breede and Gouritz WMA. The water resource situation is briefly described for each of the three major sub-areas making up this new WMA.

These are:
(i) Outeniqua Coastal Area
(ii) Karoo and Klein Karoo (including the Gouritz catchment)
(iii) Breede and Overberg catchments

This is a very largely rural WMA with very few surface water development opportunities, and thus requiring a multi-faceted strategy. Small towns will almost all have to develop local water resources to allow for growth.

The Outeniqua Coastal Area (Stilbaai to Plettenberg Bay)
These coastal catchments are ecologically sensitive, with many short, steep rivers of high ecological value. There are some small to medium-sized dams, such as the Wolwedans Dam supplying PetroSA and Mossel Bay Local Municipality, and the Garden Route Dam, supplying George and environs. Surface water resources have been almost fully developed and any prospective schemes will be economically and ecologically expensive. Alternatives need to be thoroughly explored.

This is a major growth area, popular as a retirement location and year-round holiday destination. There is large growth in year-round water requirements, with the area's importance as a holiday destination also resulting in very high seasonal peak usage. The system is generally in balance but water requirements can exceed availability at peak times. The use of available sources of water must be optimised in the light of the limited storage capacity, and peak seasonal water requirements call for a unique strategy. There must be an emphasis on water conservation and water demand management, the desalination of seawater, the use of treated water, and increased groundwater use. This mix of actual and prospective approaches includes:

- Water conservation and water demand management: fundamental in all sectors and situations to reduce losses and wastage.
- Possible small dam infrastructure including: the raising of the Garden Route Dam, a dam on the Knysna River to augment supply to Knysna Municipality, an off-channel dam supplied from the Keurbooms River for augmenting Plettenberg Bay Local Municipality's water supply, the raising of the Klipfontein Dam to augment the supply to Mossel Local Bay, and a dam on the Malgas River to augment supply to George Local Municipality.
- Desalination of seawater or brackish water: Small desalination plants were installed at Sedgefield, Plettenberg Bay and Mossel Bay during the severe drought of 2009/10. Originally intended to alleviate drought shortages, these desalination plants should be operated full-time to meet the base requirements, as these plants deteriorate when standing idle. This would reduce the need for water from storage in dams during off-peak times, ensuring its availability during times of peak water requirements.
- Groundwater is the most promising sustainable, long-term and affordable water resource development opportunity. Groundwater from the Table Mountain Group Aquifer in the Outeniqua Mountains should be able to supply coastal as well as inland towns and villages, along with some irrigation. Groundwater of poorer quality is available In smaller quantities on the coastal plains but this water will require treatment.
- Users, and especially holiday users, could be required to install rainwater tanks in order to reduce peak water requirements.

The Karoo and Klein Karoo
The area is vast and dry, with some water coming off the southern slopes of the Swartberg range. To the north, Beaufort West is the largest town in the Karoo, and largely dependent on groundwater. Beaufort West Local Municipality also has a recently commissioned water reclamation plant, providing potable water for domestic supply. Whilst groundwater is the key resource for almost all Karoo towns, rainwater harvesting using roof water tanks is important in maximising water resources available for domestic use. In Prince Albert (Local Municipality) a pilot groundwater artificial recharge scheme was constructed, storing water sourced from mountain streams in winter for use during the dry summer months.

South of the Swartberg Mountain range the main drainage is from the Olifants River, flowing west past De Rust and Oudtshoorn before joining the Dwyka River to form the Gouritz River, which itself has very little water despite its imposing canyon. The Olifants River has been seriously over-exploited for irrigation, and is ecologically compromised. The Klein Karoo Regional Water Scheme, which relies on a groundwater wellfield, is unable to meet the growing needs of Oudtshoorn, Dysselsdorp and surrounds and the area is seriously water stressed. There is no additional surface water development possible in the Little Karoo, except perhaps for a small dam in the Swartberg Mountains to augment Oudtshoorn Local Municipality's needs. The groundwater potential of the Table Mountain Group Aquifer does seem to be large enough to significantly augment the supply to these towns, and this option is now being pursued, by deep drilling.

There is a lot of good arable land available throughout the Gouritz Catchment, but irrigation is limited due to sparse and highly variable rainfall, with runoff only occasionally sufficient. There are some rural irrigation schemes, such as at Zoar and Dysselsdorp, but these barely provide enough water for subsistence farming. Existing resources have been over-allocated and further dam development is not possible, with runoff insufficient even to fill existing storage regularly. Irrigation over much of the area is primarily through opportunistic use for lucerne – relying on floodwaters and soils with good water retention capacity. This is very low assurance use, with sufficient floodwater available only once every few years. It will be very difficult to implement development schemes aimed at emerging farmers who lack the resilience to manage such high uncertainty.

The Breede River and Overberg catchments
The Breede River is already intensively utilised, with large dams such as the Brandvlei and Theewaterskloof dams, a number of medium to small dams such as the Koekedouw Dam near Ceres, the Eikenhof Dam near Grabouw and the Elandskloof Dam near Villiersdorp, and a very large number of farm dams.

The water from these dams has three major uses:

(i) extensive areas of irrigation within the catchment itself – primarily for high value crops such as deciduous fruit, especially grapes
(ii) domestic and industrial use within the catchment, and
(iii) large transfers to the Berg River catchment to supply the Cape Town Metropolitan Area and irrigation farmers along the Berg River. About 22% of the yield in the Breede River catchment is currently transferred to the Berg WMA and Cape Town. In some stretches of the river the ecological Reserve is not being fully met. The water resources of the Riviersonderend River are fully developed but the eradication of invasive alien plants would go some distance towards providing the water necessary to meet the ecological water requirements in that river.

By building more dams the resource could be developed further and more water could be transferred to the Berg catchment, or used in the Breede catchment itself - taking full consideration of the environmental and financial implications. Feasibility studies of interventions identified in the Western Cape System Reconciliation Strategy are being conducted to determine the cost of further water resource development in and transfers to the Berg River, and these costs will be compared to other options available for augmenting water supplies to Cape Town, such as re-use of water and desalination. At the same time the Breede Catchment Management Agency advocates, in its recently completed Catchment Management Strategy, for the use of the remaining water for development in the Breede catchment itself. It is the function of the Department of Water Affairs to make the final decision on the best use of this water in the national interest. This National Water Resource Strategy retains the option to transfer further water to the Berg WMA, but a final decision will only be made after the costs and benefits of all options have been properly considered. So, too, development will not be allowed in the Breede catchment without full consideration of the environmental costs, and until the needs of the two catchments have been carefully compared.

Brandvlei Dam could be raised but this cannot be justified while so much water is being lost through inefficient distribution via earth canals. The town of Worcester (Breede Valley Local Municipality) has sufficient water from local sources.

Salinisation through irrigation is also a major problem throughout the Breede catchment, severely impacting on the water quality in the middle and lower reaches of the river, and this would only be exacerbated by further upstream developments.

The Breede Valley is bordered by mountains of the Table Mountain Group sandstones, which have huge potential for groundwater development, both for augmenting municipal supplies and for irrigation use. In the Hex River Valley the extensive groundwater resource has to a large extent been over-exploited, but with good management these problems should be overcome.

The catchment of the Palmiet River (Elgin/Grabouw) is intensely farmed in the upper and middle reaches, producing fruit for export, with irrigation water coming mostly from privately owned dams. Water can also be transferred from the Palmiet River to Cape Town via the Rockview and Steenbras dams. The lower reaches of the Palmiet River have long been highly protected as part of the Kogelberg Biodiversity Reserve and the ecological status of this river must be maintained.

The Overberg catchments are used primarily for dryland farming - canola, grains and clovers as well as livestock. The Ruensveld East and Ruensveld West Rural Water Supply Schemes are operated by Overberg Water, supplying domestic and stock water where the groundwater resource is inadequate or of unusable quality. The distribution system consists of hundreds of kilometres of pipelines, most in urgent need of refurbishment, being more than 40 years old. The Buffeljags River near Swellendam (Local Municipality) still has water available for the development of about 140 ha of irrigation, and this has been set aside for emerging farmers.

Groundwater is important throughout the Overberg, including supplies to farming communities and coastal resorts, but salinity is a problem. It would be significantly cheaper to desalinate this groundwater than it would be to desalinate seawater, and this is a potential option. Hermanus (Overstrand Local Municipality) already gets high quality water from the Table Mountain Group Aquifer. Further development of this resource must be investigated, as this town and surrounding resorts will be requiring additional water supplies in the near future due to the high population growth being experienced.

9 Berg and Olifants-Doring Water Management Area

Comprising the original Berg WMA and the Olifants-Doorn WMA

The water resource situation in this WMA is discussed under (i) The Berg River Catchments, where focus is placed on the 'Western Cape Water Supply System', and (ii) The Olifants and Doring River catchments, with resources managed as a single system. It is expected that climate change will have particular impact on this WMA.

Both the Berg and Breede Rivers have now been almost fully developed through the need to supply the City of Cape Town. Little or no more water can now be expected from the Breede River system. Long-term thinking must consider that water will only become scarcer and much more expensive. The Olifants-Doring system does not have the water, and it is too distant, to provide any solutions for the City of Cape Town.

Berg River catchment

The Berg River catchments comprise the Berg River itself, along with a number of smaller coastal catchments. Water resources are planned for and managed through the Western Cape Water Supply System. This System serves more than 3.2 million people, providing water to the City of Cape Town, Overberg, Boland, West Coast and Swartland towns, as well as to irrigators along the Berg, Eerste and other local rivers.

The Berg River Dam is the first major dam in South Africa that has been designed and constructed to make full provision for the ecological water requirements of the river, as required in terms of the National Water Act, 36 of 1998.

A Water Reconciliation Strategy was completed for the area in 2007 and a Steering Committee established to oversee the implementation and regular update of the strategy. One of the findings of the Strategy study was that the Western Cape Water Supply System would be in deficit by 2013 unless water conservation and water demand management measures are successfully implemented, especially in the City of Cape Town. Effective water conservation and water demand management can delay the need for the next augmentation scheme to 2019. Decisions on the implementation of further supply options must be taken in 2013.

The option available for sourcing additional water for the Western Cape Water Supply System (WC WSS) as the immediate priority is to use less water by improving efficiencies and curbing losses and wastage.

Options for actually increasing water supplies to the economic heartland of the Western Cape include:
(i) Some surface water developments (Upper Breede and Berg rivers)
(ii) Large-scale groundwater development (from the Table Mountain Group Aquifer and from coastal aquifers)
(iii) The re-use of water
(iv) The desalination of seawater

Water shortages and salinity in the Lower Berg / West Coast area bring into focus the debate on the importance of agriculture to jobs and the local economy vs. the water it requires. Costs and benefits must be very carefully weighed before water is moved out of agriculture to support urban and industrial requirements.

Water conservation and water demand management (WCWDM) Water either conserved or not used is not strictly speaking a source, but success in the implementation of water conservation and water demand management measures by all water user sectors is essential if water restrictions are to be avoided. The Western Cape System could soon come under stress given the continued rapid growth of the City of Cape Town, which has an estimated immigration influx of approximately 50 000 people p.a. and is also committed to improving service levels to the poor. WCWDM has to be addressed both by the municipality (curbing losses due to leaking distribution systems, high pressures, and poor plumbing in RDP housing projects), and by users (water saving and efficient use). It is essential that adequate funds and human resources be secured to fully implement the City of Cape Town's 10-year WCWDM Strategy.

WCWDM measures are being implemented in all towns in the area, with the most rigorous implementation in the Cape Winelands District Municipality. Here great effort is being made to improve the operation of WWTWs to improve the quality of effluents discharged to the rivers, and to install or replace bulk water meters enabling better management of losses.

Surface water storage infrastructure: Infrastructure options include:
a) Augmentation of the Voëlvlei Dam through pumping water directly from the Berg River, with a potential raising of the dam as a later phase.
b) The Michell's Pass Diversion in the upper Breede River, with transfer to the Voëlvlei Dam.

Other than the prospect of raising the Voëlvlei Dam, no other significant storage schemes are planned in the Berg River catchment. The possibility of raising the wall of the Lower Steenbras Dam will be investigated in a future study under the WC WSS, but the serious concerns about the foundations make this a low priority.

Groundwater: Increasing groundwater supplies is an important option, and utilisation of the Table Mountain Group Aquifer is likely to increase from pilot to operational level. The impacts of this utilisation will have to be carefully monitored.

The coastal groundwater aquifer serves Atlantis on the West Coast; this aquifer incorporates the oldest artificial groundwater recharge scheme in the country. The Langebaan Road Aquifer serves the Saldanha area. Artificially recharging this aquifer with surplus winter water has not yet proven successful due to drilling for agricultural water supplies damaging the integrity of the aquifer.

The re-use of water: Water re-use can provide a large source of water for all coastal cities. In the case of the City of Cape Town most treated effluent is discharged into rivers or directly to sea through marine outfalls. There are few industries that could make use of treated water, so most of the available effluent would have to be treated to potable standards. The feasibility of developing this potentially large source of water is currently being studied by the City of Cape Town.

Desalination: The City of Cape Town is planning to undertake a feasibility study into desalination to supplement the water resource. A desalination plant can be implemented relatively quickly should surface water options not prove feasible, or in the event of technical difficulties in the re-use of water. Desalinated water is also a resource that is not subject to the vagaries of climate change.

The Olifants and Doring River catchments
This area comprises:
(i) the well-watered valleys of the Olifants River catchment with extensive commercial irrigation sourced from the Clanwilliam and Bulshoek dams
(ii) the arid Doring River catchment
(iii) the highly developed Sandveld area forming the western coastal boundary of the original Olifants-Doorn WMA

The Olifants River is highly impacted by abstraction for irrigation in the upper reaches. The reservoir of the Clanwilliam Dam also drowns a long reach of the river. A Preliminary Comprehensive Reserve has been determined for the Olifants River with the recommendation that it is impractical to try and restore the river to a more natural system, and that water should not be taken back from existing lawful users for this purpose, due to the negative impact this will have on the area's economy. However, to make up for this, no further development should be allowed in the Doring River, which joins the Olifants River below the Clanwilliam and Bulshoek dams. The only exception to this could be for small off-channel dams in the Koue Bokkeveld, which can be filled using high levels of winter water. The protection of the Doring River is aimed at securing the ecological integrity of the lower reaches and estuary of the Olifants River, the latter being a major permanently open estuary and fish breeding area.

The Sandveld is drained by the Verlorenvlei, Langvlei and other smaller rivers. The Verlorenvlei is an internationally declared Ramsar site. There is a long recognised problem of over-abstraction of groundwater for irrigation, threatening both the Verlorenvlei and other wetlands, as well as the sustainability of all agriculture in the region. An effective management plan for this area still needs to be implemented.

Options for sourcing additional water in the Olifants-Doring:

(i) **Infrastructure storage:** The Olifants River has one major dam, the Clanwilliam Dam, serving large-scale downstream irrigation and various towns. Major rehabilitation work is required on the dam's structure to meet modern dam safety standards and construction work is planned to start in 2013. With this work required, the simultaneous raising of the wall becomes economically attractive and it is proposed that the dam should be raised by 13 metres. The additional yield will increase the assurance of supply to existing irrigation farmers and towns, and will also provide bulk water to emerging farmers. Agreement on a funding model for the raising of the wall is still required.

(ii) **Groundwater:** Groundwater, although not of a very good quality due to high salinity, is important especially to higher lying towns such as Nieuwoudtville (Hantam Local Municipality). Vanrhynsdorp (Matzikama Local Municipality) has accessible groundwater in a developed well-field, but currently uses only Olifants River canal water, due to its better quality.

(iii) **Desalination:** Lamberts Bay (Cederberg Local Municipality) is now augmenting its supplies by desalinating water abstracted from beach wells.

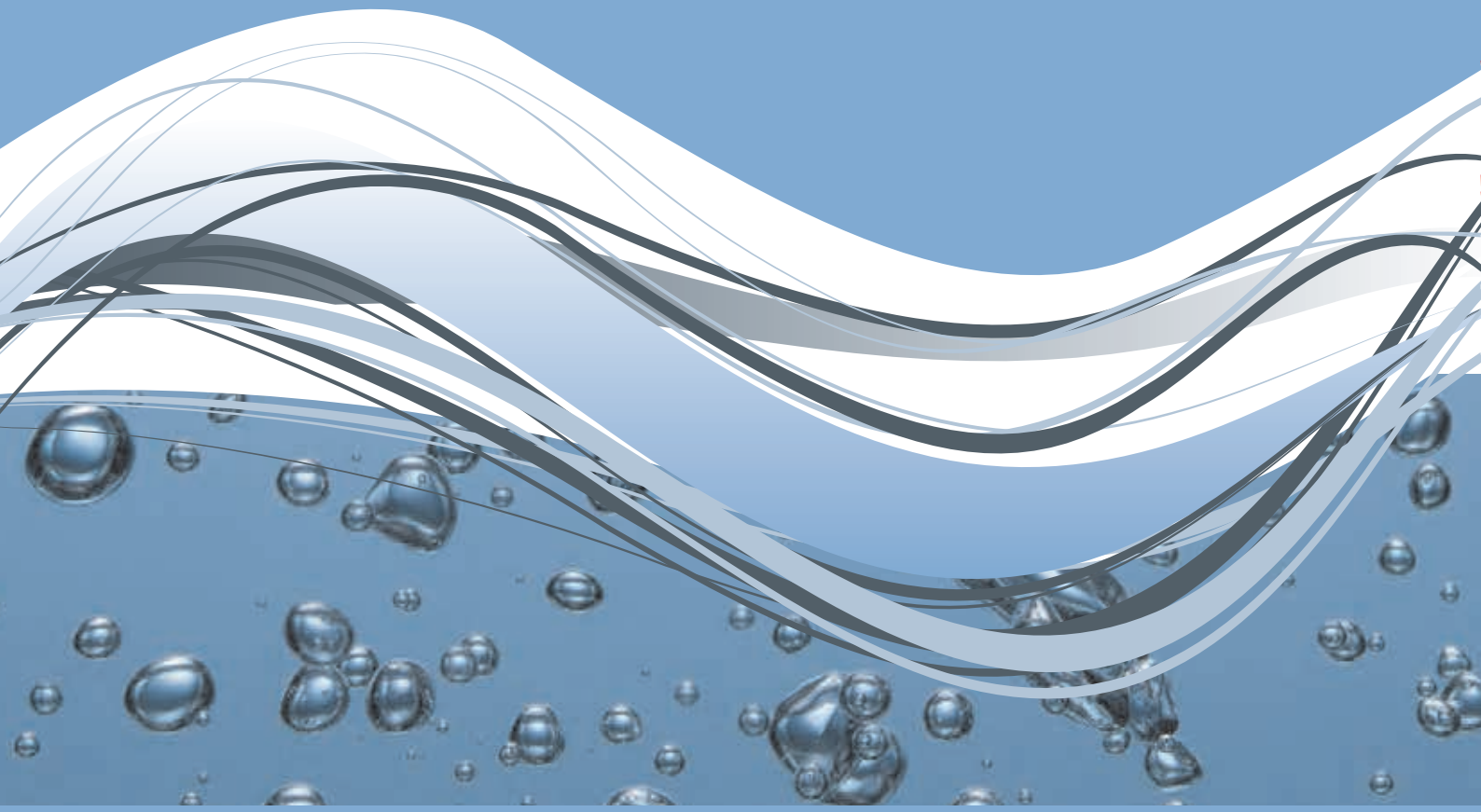
Climate change

The Berg and Olifants-Doring WMA is seen as the most likely of all South African Water Management Areas to experience declining rainfall through climate change.

Temperature and evaporation will increase, as also the variability in rain events. All these factors could affect the available yield of water in Western Cape dams and rivers, in addition to increasing water requirements. This uncertainly adds urgency to the need for diversification in water resource solutions starting with the implementation of further WCWDM measures, the re-use of water, and to complete the studies into the feasibility of desalination as an augmentation option as well as large-scale development of the Table Mountain Sandstone Aquifers for the City of Cape Town.

Plans must be prepared for the situation where climate change starts to impact on the availability of water. However the size of this impact and the timing are very uncertain. Appropriate monitoring, especially of rainfall, and rigorous analysis of this data, is required before very expensive infrastructure is built for mitigation.

Annexure B
Understanding Water Resources



ANNEXURE B
UNDERSTANDING WATER RESOURCES

Effective water resources management is dependent on all water users and water managers playing their part. Government alone cannot do it. In order to implement the NWRS2, it is important that South Africans generally understand how the water cycle works, and how their actions create impacts in this cycle. It is equally important to understand the context of water resources in South Africa, and the specific challenges that we face as a country. This section, therefore, sets out some important facts about the water cycle and the specific water challenges in South Africa.

The water (hydrological) cycle

"…water is a scarce and unevenly distributed national resource which occurs in many different forms which are all part of a unitary, interdependent cycle" (National Water Act, Act No 36 of 1998).

Unlike oil, which is a non-renewable resource, water is a renewable resource which operates in a closed loop system **(Figure 1).** Heat results in water evaporation from the land and water resources. As the water vapour rises, it cools and condenses to form clouds. When conditions are appropriate, the water in the clouds is released as precipitation (rain, hail, snow or sleet). This precipitation evaporates back into the atmosphere, infiltrates the ground to become soil moisture or groundwater or runs off into surface water resources such as rivers, estuaries and wetlands. Plants take up water from the soil and transpirate some of it into the air, contributing to the return of moisture into the atmosphere, and back into the cycle of evapotranspiration and precipitation.

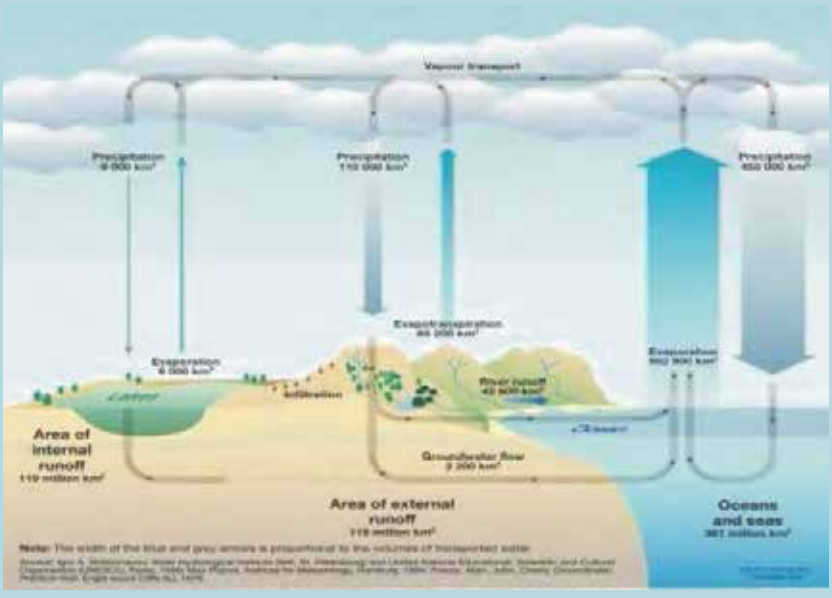


Figure 1: The water cycle (Source: Sarni, W. 2011. Corporate Water Strategies. Earthscan LLC, Washington DC: 31.)

Groundwater either seeps (discharges) into streams, rivers, and oceans, or is released back into the atmosphere through plant transpiration.

Figure 2: Diagram of a catchment area (Source: http://prairierivers.org/tag/watershed-planning/)

Infrastructure, such as dams, enables the provision of a reliable supply of water, and to increase the amount of water available for use, by storing water that would otherwise run into the sea. Storage of water in dams enables a reliable supply of water even during a drought. Other technologies are also available for increasing water availability, such as desalination.

The challenge is, however, that dams and general use of water for social and economic purposes have negative impacts on aquatic ecosystems, which provide important goods and services. The challenge, therefore, is how to balance the use of water with the protection of aquatic ecosystems. The NWRS2 provides strategies that aim to achieve this.

Basic Facts about Water

Examining some of the facts about water use and scarcity in a global context helps to underpin the case why governments and companies are now addressing water as a strategic issue. This case becomes more compelling when one examines the specific water context in South Africa. This section sets out this picture as a context within which the NWRS2 is set.

More than one-third of the world's population – roughly 2.4 billion people – lives in water-stressed regions and this number is expected to rise. 3.6 million people die each year from water-related disease and 98 per cent of water-related deaths occur in the developing world. 884 million people lack access to safe water supplies – approximately one in eight people. Poor people living in the slums often pay five to ten times more for water than wealthy people living in the same city.

Less than 1 per cent of the world's fresh water (or about 0.007 per cent of all water on earth) is readily accessible for direct human use. **Figure 3** below shows the volume of all water on earth, relative to the size of the earth (large water drop). The middle size blue drop represents the volume of the world's liquid fresh water (including in swamps and groundwater), while the tiny bubble represents surface fresh water[1].

While water is the most abundant resource on Earth, 97.5 per cent of it is too salty for human consumption and crop production. Much of the fresh water, an estimated 35 million cubic kilometres, cannot be accessed for use since it is locked either in the ice cover of the Arctic or Antarctic or in deep aquifers. Thus, the physically accessible fresh water potential of the world is only 90 000 cubic km per year.

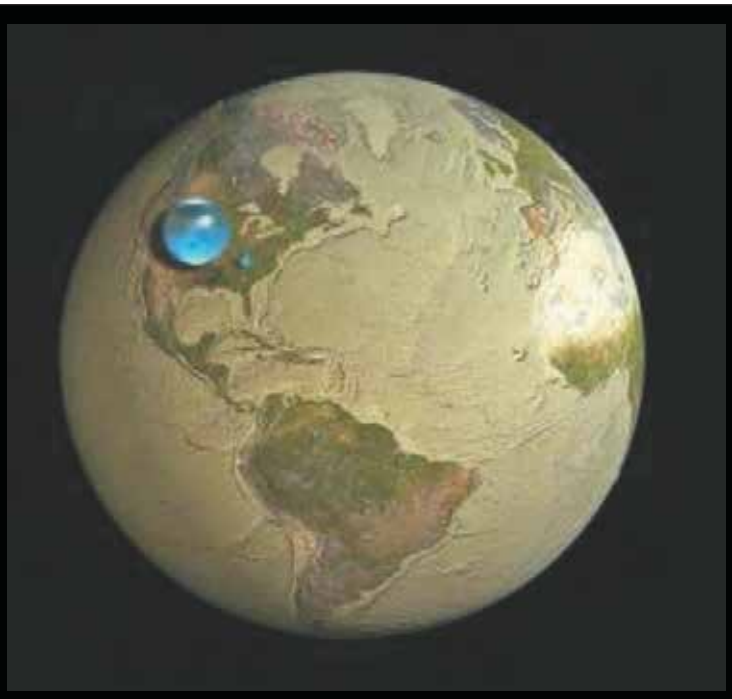


Figure 3: Volume of total water and freshwater relative to the size of the earth

Available water is described as blue water (water in rivers, dams, groundwater, etc) and greenwater (soil moisture). Greenwater is important in dryland agriculture. Not all blue water can be used due to economic, technological, and environmental limitations, spatial and temporal mismatch between fresh water availability and demand, and pollution-induced quality deterioration.

Desalination and water recycling can increase water supply, but these options are relatively costly, and only relevant in specific contexts.

Improving water use efficiency is a promising avenue for supply augmentation in view of the extensiveness of water losses and resource underutilization. Since this option helps to realize hidden resource potential within the existing supply limits, it augments supply even in the absence of new water development projects and also prevents further ecological impacts arising from new infrastructure development or increased abstraction.

Water quality is a significant problem in most countries. Pollution-induced quality deterioration not only reduces the benefits of available supply but also leads to a harmful environmental and health hazards. Water-related natural disasters such as floods and droughts are potential threats to human life, both directly and indirectly. In addition to the human costs, there are also economic losses from crop and property damage.

Understanding water scarcity

South Africa has low levels of rainfall relative to the world average with high variability as well as high levels of evaporation due to the hot climate, and increasing challenges from water pollution. All of these pose constraints on the amount of water available for use.

Rainfall is unevenly spread across the country's catchments leaving most of the northern and western parts dry **(Figure 4).** Average rainfall ranges from < 100 mm/a to over 1 500 mm/a, with an average of approximately 450 mm/a. Linking this low rainfall rate to the high level of aridity results in a mean annual runoff (MAR) of less than 10% - a very low percentage when compared to countries with similar average rainfall. Rainfall patterns, and subsequent runoff, are highly seasonal (with short wet seasons and long dry seasons in many parts of the country) and variable from year to year. This inter- and intra-annual variability of the hydrological system complicates water resource management in South Africa.

[1]Credit: Howard Perlman, USGS; globe illustration by Jack Cook, Woods Hole Oceanographic Institution (©); Adam Nieman. Data source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources (Oxford University Press, New York)

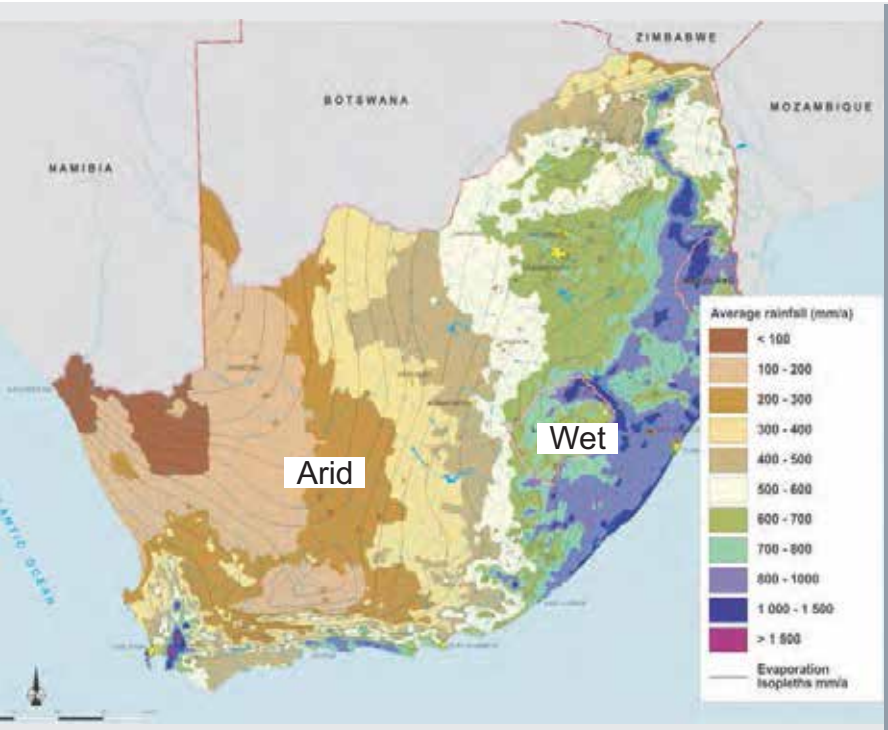


Figure 4: Rainfall and evaporation across South Africa

Water is scarce
The low rainfall and high evaporation results in South Africa being the 30th driest country in the world. As an example, the Zambezi River carries more than ten times, and the Congo River more than a hundred times as much water as the Orange River, the largest river in South Africa. The amount of water that reaches and flows through our rivers is estimated in the region of 49 040 million cubic metres per annum (Mean Annual Runoff – MAR in Mm^3/a). A portion of the MAR needs to remain in the rivers and estuaries to support ecological functioning of the catchments. In many water management areas, the ecological portion of the "Reserve", which specifies the quantity and quality of water required for the protection of aquatic ecosystems, is not yet fully implemented. The amount of water that can be abstracted at high assurance (the yield) from surface water resources is estimated at 10 240 Mm^3/a which is approximately 20% of the MAR.

Another issue of concern is that invasive alien plants are estimated to currently reduce the yields of dams and run-off-river supply systems by about 695 Mm^3/a.

Water resources are unevenly spread across South Africa
The variable rainfall distribution and characteristics give raise to and unevenly run-off and distribution of water resources across the country, with more than 60% of the river flow arising from only 20% of the land area. To overcome the uneven spread of water resources and to manage floods and droughts, more than two thirds of the country's MAR is stored in dams. Most of the economically available yield from surface water resources has been fully developed and utilised, and opportunities for developing new and economic dams are few.

Where additional water is available, such as the uThukela, Mzimvubu and Pongola basins, it is located in relatively remote areas, far from existing centres of demand. Surface water from dams and direct abstraction from rivers accounts for 9 500 Mm^3/a, with a significant volume of the surface water yield moved via inter-basin transfers to areas in the country where water requirements exceed supply. An example is the Lesotho Highlands Water Scheme which supplies water to Gauteng through transfer from Katse and Mohale Dams in Lesotho to the Vaal WMA.

This high development and regulation of water resources has caused significant changes in the flow regimes of rivers resulting in negative impacts on the environment and loss of ecosystem functioning. Furthermore, the outcome of poor land-use practices has also resulted in sedimentation of river channels, lakes and reservoirs, and changes in hydrology.

Fresh water and its development are at its limit
To date, South Africa's water security is mainly reliant on surface (fresh) water and its development. Based on water reconciliation studies, it is clear that surface water availability and its remaining development potential will be insufficient to support the growing economy and associated needs in full. Water development potential only exists in a limited few water management areas, whilst serious challenges remain in the majority of water management areas.

To meet growing demands, South Africa will need to exploit alternative resources.

Although the regulatory framework and the institutional arrangements have changed since the advent of democracy, one aspect remains constant: water scarcity – whether quantitative, qualitative or both – which originates as much from inefficient use and poor management as from real physical limits.

Figure 5: Water Management Areas of South Africa and inter-water management area transfers

High variability of water flow is the norm, and the base flow varies from very low to zero. At present, there is a well-developed infrastructure, with more than 4 395 registered dams in South Africa, of which 2 528 are water supply related. Despite the good infrastructure, the occurrence of floods and droughts are part of the "normal" water cycle and water restrictions and flood management are a critical part of the water business. And despite the good infrastructure, the poor and marginalised experience water scarcity most intensely, particularly in under-developed rural areas and areas such as the former homelands.
In many parts of the country, we are fast approaching the point at which all of our easily accessible freshwater resources are fully utilised. All South Africans must recognise this situation so that necessary steps are taken to assess current and future demands for water. This will not be an easy task, but with the necessary resolve to plan and implement the required interventions, a secure water future can be achieved.

It is important to recognise, however, that there are very different experiences of water scarcity for different groups in South Africa. In particular, water scarcity is experienced on a daily basis by the rural poor, many of whom still do not have access to potable water supply, and who also do not have access to reliable water supply for productive purposes. These communities are also the most vulnerable to droughts and floods. When dealing with water scarcity, therefore, the plight of those who experience water scarcity most intensely must take priority.

The present water supply situation has created a false sense of water security within the privileged sectors of South African society. Marginalised and poor communities have, on the other hand, have always experienced high levels of water insecurity.

It must be noted that, as at 2012, South Africa has had 16 consecutive years of above-average rainfall in the majority of summer rainfall areas and in these areas the last major drought was more than two decades ago. This trend is unlikely to continue. Other areas such as the Western Cape and parts of the Eastern Cape suffered from drought. The potential for drought in other areas and the impacts of climate change place a particular imperative on the effective management of water resources, within the framework of this NWRS2.

For the NWRS1 in 2004 DWA undertook a number of studies to develop Internal Strategic Perspectives for each Water Management Area. Subsequent to this, a number of further studies have been done to update the information supporting the reconciliation of water requirements and the available resources. In this, DWA has taken a strategic approach to focus the updating of water situation assessments on the areas where this is most urgent. There have also been studies to assess the water situation in terms of quality (DWA, 2011).

The NWRS1 showed that the majority of the water management areas (WMA) have water deficits (i.e. the water requirements exceed availability with current infrastructure) despite significant transfers from other catchments. Only a few selected WMAs such as parts of the Eastern Cape had surplus water. There were, already, concerns that more WMAs would have fresh water deficits by the year 2025. Most of the economically available yield from surface water resources over large parts of the country has been fully developed and utilised. Where additional water is still available, such as in the uThukela, Mzimvubu and Pongola basins, it is located in relatively remote areas far from existing centres of demand.

Opportunities for economically viable new dams are few and far between (DWA, 2010), and the costs of transfer of water per cubic metre to locations where water is needed are also rising with longer distances.
For the purpose of water planning, the Department of Water Affairs (DWA) plans with 'available water' and uses a 98% assurance of supply (DWAF, 2004). This means that water can be abstracted at the determined 'yield', 98 out of 100 years on average. There is about 10 000 million cubic metres per year available with this level of assurance. In most areas where there are water deficits or where the system is considered 'in balance', the probability is that water shortages are experienced more than 2 out of 100 years. Water shortages have become part of life in South Africa.

Approximately 25% of the mean annual runoff (MAR) of 49 000 million cubic meters per annum needs to remain in the rivers and estuaries to support ecological functioning of the catchments, depending on the specific river systems. In many water management areas the ecological portion of the Reserve is not yet fully implemented.

Many dams and associated water resources infrastructure were built more than 40 years ago. While the main structures may have an extremely long life, spillways, gates, pumps, pipelines and canals and associated infrastructure, need regular maintenance and occasional major rehabilitation to extend the lifespan of these assets for which funding is required. There are also considerable backlogs in the rehabilitation of water infrastructure owned by the municipalities.

Groundwater
Groundwater is a significant resource in many parts of the country although local yields are usually quite low. The most recent estimate of sustainable potential yield of groundwater resources at high assurance is 7 500 million cubic metres per annum, while current groundwater use is estimated at around 2 000 million cubic metres per annum. Allowing for an underestimation on groundwater use, potentially about 3 500 million cubic metres per annum is available for further development. This resource is, however, sparsely distributed and often not readily available at points of demand. This is exacerbated by the levels of knowledge and information on the groundwater resource.

Some of the most favourable areas / aquifers regarding groundwater availability include: the Dolomites of the West and Far West Rand; Table Mountain Group Aquifers of the Western and Eastern Cape; Coastal sand aquifers in the Western and Eastern Cape, and northern KwaZulu-Natal. Other high yielding aquifers include basement granites in the Polokwane-Dendron-Coetzerdam area, alluvial deposits along sections of major rivers such as the Limpopo, and parts of the Karoo Sequence associated with dolerite dykes and ring structures.

Water resource quality
The quality of our water resources, both in terms of water quality, as well as river habitat and bio-diversity, is a major concern. The situation regarding acid mine drainage and municipal wastewater pollution has reached unacceptable levels. In terms of river health, almost 60% of river ecosystem types are threatened, with 25% of these critically endangered. Wetland ecosystem types are of even more concern with a 65% identified as threatened, including a staggering 48% critically endangered. This situation demands drastic intervention.

The DWA has conducted a national review of the water quality status **(Figure 6)** and trends that measure, assess and report on the current state and appropriate temporal trends of selected groups of water quality indicators in South African surface water resources. Results of the review showed that the levels of nutrients in the country's water resources are of major concern. Only 10% of the monitoring sites showed compliance with the prescribed tolerable range RQO (>0.015 mg/l to <0.025mg/l) for phosphate. Levels of non-compliance at national scale are currently 88%. A key contributor to the deterioration of water quality of South Africa's water resources and the marked increase in nutrients and microbiological contaminants with associated health risks are the result of untreated or partially treated municipal wastewater discharges from sewage treatment works. The resulting eutrophication in major dams has caused health threats to livestock and humans downstream, apart from damaging the ecosystem. Also, water treatment costs increase with higher nutrient loads.

Acid Mine Drainage (AMD) has been reported from a number of areas within South Africa, including the Witwatersrand Gold Fields, Mpumalanga and KwaZulu-Natal Coal Fields and the O'Kiep Copper District. The Western, Central and Eastern Basins have been identified as priority areas requiring immediate action because of the lack of adequate measures to manage and control the problems related to AMD, the urgency of implementing intervention measures before problems become more critical and their proximity to densely populated areas. There is also an estimated 62 Mℓ/day post-closure decant from coal mines in the Highveld Coalfield and around 50 Mℓ/day of AMD discharging into the Olifants River Catchment, reducing the quality of water for irrigation and municipalities, as well as damaging freshwater ecosystems. An inter-ministerial committee was set up which made recommendations to address problems associated with AMD.

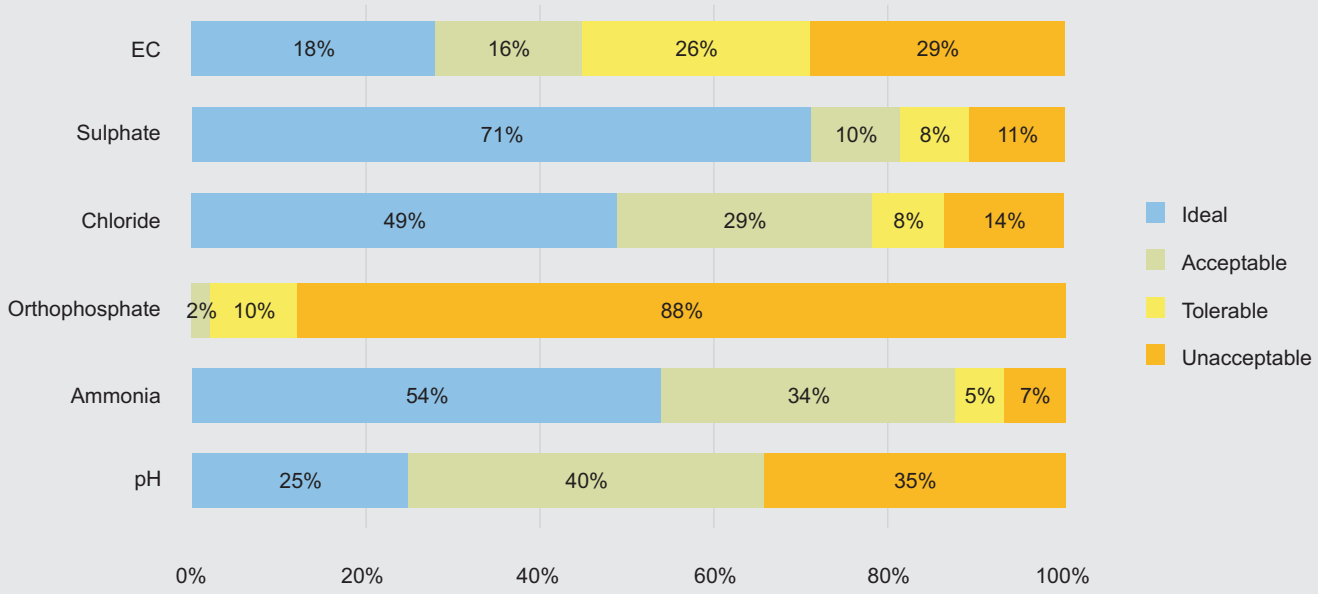


Figure 6: National percentage compliance of current in-stream water quality to Resource Quality Objectives

Salinisation is also a water quality problem in many catchment areas. Elevated levels of sulphate, sodium and chloride pose a risk to industrial water supply, agricultural water supply and aquatic ecosystem health. There are two main anthropogenic sources for salinisation: mines (acid mine drainage); and irrigation return flows from large-scale irrigation schemes. Coal mining activities are expanding in the Olifants and Vaal catchments thereby increasing the risk of salinisation. The Waterberg coalfield will be further developed in the future adding additional stress to the water resources situation.Aesthetic pollution of streams and rivers is not monitored in official reports, but also calls for attention. Much more can be done to remove litter from urban storm water runoff before this enters rivers.

Key pressures on freshwater ecosystems, expected to be exacerbated by climate change include: over-abstraction of water; water quality problems; habitat destruction especially from bulldozing in riparian zones; development in the estuary functional zone; and impacts of alien invasive fish species.

Shared water resources
South Africa shares four major river systems with six neighbouring states (Zimbabwe, Botswana, Mozambique, Swaziland, Lesotho and Namibia). International agreements on water sharing are in place in all of these river basins, in line with the Revised Protocol on Shared Watercourses in the Southern African Development Communnity. These shared river basins raise the importance of water in the regional integration agenda in SADC. South Africa's policy and legislation recognises international obligations.

Annexure C
National Desalination Strategy

May
2011

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

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1

INTRODUCTION

1.1 Context and purpose

The National Water Resources Strategy[1] (first edition, 2004) indicated that whilst a surplus of fresh water still exists in the country as a whole, more than half the water management areas suffer from a current or projected water deficit. Since the publication of the first National Water Resource Strategy (NWRS1), water resource Reconciliation Strategies have been updated and developed for all the major water management areas. Many of these water resource Reconciliation Strategies indicate that the reclamation and re-use of irrigation return flows, mining impacted waters, industrial effluents and treated municipal sewage effluents will in future be required to balance water requirements with availability. The quality of return flows and treated effluent may, however, not be suitable for re-use by downstream and other water users. The implementation of desalination can render return flows, treated effluents and brackish groundwater fit for use by a wide range of water users. Desalination technologies typically do not only remove salts from water, but also a spectrum of other pollutants such as metals, nutrients and organics. The major cities and smaller towns located along the coast may also require the desalination of sea water to meet their future needs. Within the context of the National Water Resource Strategy 2, it is therefore important to consider a strategy for desalination.

The *Integrated Water Resource Planning for South Africa, A Situation Analysis 2010*[2] also recognizes desalination of a variety of waters as an important current and future source of water.

This Strategy document contains a strategic approach to the planning, development and implementation of desalination to support more productive development and utilization of our national water resources. This strategy may be considered to be a sub-component of, and is consistent with, the recently revised and updated National Water Resource Strategy 2 (NWRS2).

1.2 What is desalination?

Desalination is a collective term for a wide spectrum of water treatment technologies which can separate salts from water and render a useful water product. Desalination technologies can be applied to the broad range of water and wastewater containing salts from brackish water to sea water.

1.3 Where can desalination be used?

The salt content of a used water or effluent is frequently a key consideration in the re-use of water. A high salt content or the presence of specific salt species may be a constraint to the use of the water. Desalination can then be applied to beneficiate the water and to render it fit for re-use.
Many municipal, industrial and mining operations use water and discharge the used water back to the water resource. In fact, many water use licences authorizing the productive and beneficial use of water require the used water to be returned to the natural water resource. Used water will, however, typically require some form of treatment (for removal of pollutants introduced by the use of the water), before discharge back to the natural water resource. In some cases, the salt content of the used water must be reduced before discharge and desalination would then be required.

Seawater is a vast source of water available to communities along the coast line. Desalination would be required to render the seawater fit for human consumption and the spectrum of commercial, industrial and mining uses of water.

A number of the potential applications of desalination to provide suitable water fit for use to different water users are reflected on **Figure 1**.

The main applications of desalination in the South African context are likely to be:

- Development of brackish surface water or saline effluents as a water resource
- Development of brackish groundwater as a water resource
- Development of seawater as a water resource
- Treatment of industrial effluents and return flows to achieve discharge standards
- The treatment of mine water to protect the environment and/or as a water resource for re-use
- Treatment of mining/industrial effluents to allow for recycling on a facility moving towards a zero effluent discharge target

[1] Department of Water Affairs and Forestry. National Water Resources Strategy. First Edition. September 2004.

[2] Department of Water Affairs. Integrated Water Resource Planning for South Africa. A Situation Assessment 2010. Report No P RSA 000/00/12910.

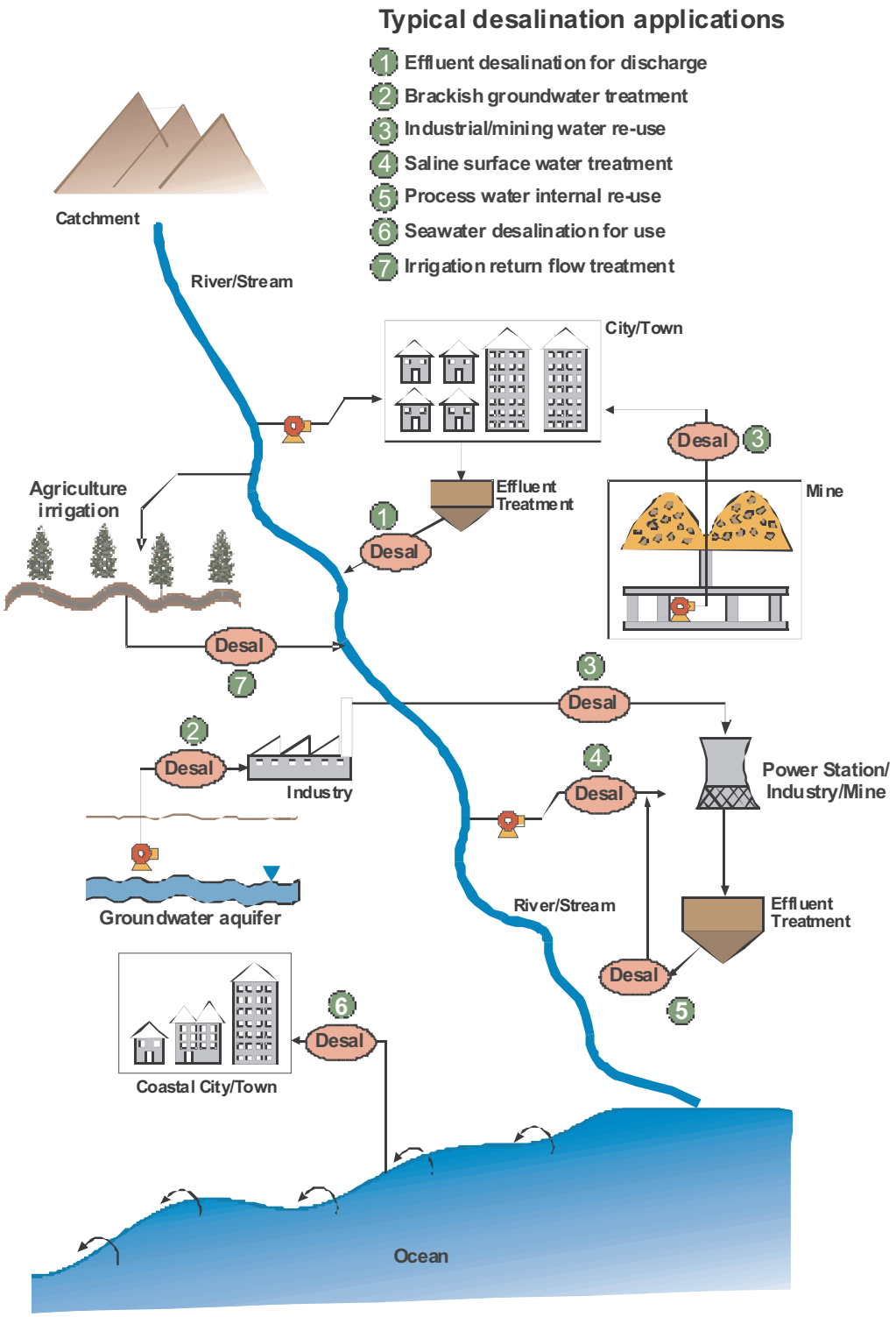

Figure 1: Possible Desalination Applications in the Man Made Water Cycle

1.4 What kinds of technology are available?

A large variety of proven water desalination treatment technologies exist. These can be categorised into four groupings: distillation, membrane-based, ion-exchange and precipitation. All four groupings may be applicable to South Africa:

- Distillation processes, such as multi-effect distillation, where there is sufficient waste heat available, for example, adjacent to a nuclear power station facility. This will become more of an option if South African pursues a Nuclear Fleet strategy as proposed in the Integrated Resource Plan (IRP, 2010)[3] .
- Membrane processes, such as nanofiltration and reverse osmosis. Reverse osmosis is a leading contender for many applications of desalination including seawater desalination, due to the lower energy requirements when compared to distillation processes. Electrodialysis, which is also a membrane based desalination process employs ion-selective membranes and electrical polarity to desalinate water.
- Chemical precipitation processes such as the barium sulphate or ettringite process, for the removal of selected ions and recovery of minerals. This technology is typically used in the processing of mine process effluent or mining decant.
- Ion exchange processes, typically used for process water where very low salinity is required, such as boiler feed water and for treatment of brackish water or where specific ions are to be removed, such as hardness.

Within each of these categories of treatment technologies, many variations and combinations are developed and applied to many different types and concentrations of brackish and saline waters. Further detail on the technologies is given in Appendix 1 for reference.

1.5 Examples of desalination applications

Many examples of the successful application of desalination technology exist both locally and internationally. Locally, some examples of typical applications are as follows:

- Brackish groundwater desalination by reverse osmosis to provide a reliable water supply to small towns and communities along the West Coast.
- Desalination of process water for use in a variety of industries including petrochemical, pulp and paper, textiles, iron and steel and minerals processing.
- Water desalination for specific water uses, requiring a very high quality water on coal fired power stations, usually employing a combination of processes such as reverse osmosis followed by ion exchange.
- Mine water desalination to produce a water fit for a variety of users and for stream discharge using reverse osmosis or chemical precipitation processes on the Mpumalanga Highveld coal fields.
- Municipal wastewater desalination to produce a water fit for re-use by industry and recreational uses.
- Seawater desalination to supplement the municipal water supply to a number of towns and communities along the Southern and Eastern Cape Coastline, employing mainly reverse osmosis membrane processes.

THE NEED FOR DESALINATION IN SOUTH AFRICA

2.1 Limits to fresh water availability and options for further development

As the conventional surface and groundwater resources are developed to their safe and reliable yields, other sources of water need to be considered. The water Reconciliation Strategies compiled for a number of key catchments supplying the large metropolitan areas, (Integrated Water Resource Planning for South Africa, 2010)2 confirmed that the future water requirements can only be met by a combination of:

- Further surface and groundwater resources development
- Management of return flows and maximising re-use
- Desalination
- Rainwater harvesting
- Reduction of demand through water conservation and water demand management
- Catchment rehabilitation and management measures

Two of these strategies for achieving a balance between the available water resources and growing water requirements involve desalination and are becoming more relevant as the options for securing additional resources through the other strategies are reduced.

2.2 Increasing water quality problems

Some of South Africa's receiving water bodies, streams and dams have limited further capacity to receive salt loads without impacting the downstream users. For example, in the Vaal River system, water is released from the Vaal Dam to effectively dilute salinity originating from mining, industrial and municipal discharges. The longer term approach is to manage the salinity at source and in some cases this may require desalination of specifically mining and industrial effluent discharges.

As the knowledge related to the protection of aquatic ecosystems grows, the importance of salinity in general and specific salt species in particular is becoming highlighted. It can be expected that the progressive implementation of the water quality component of the aquatic Reserve will place the discharge of water containing various forms of salinity under increasing scrutiny. This may require the desalination of wastewater and effluents at source, or at least before discharge to a natural stream or aquifer.

[3]Department of Energy. Integrated Resource Plan. Revision 2. Draft Report. October 2010.

2.3 Increasing variability in rainfall as a result of climate change

The reliability and availability of natural water resources are impacted by the effects of global climate change. The long term impacts of climate change on water resources are not clearly established, but increased variability in the rainfall and runoff patterns is becoming apparent. An industrial, mining or municipal effluent is a relatively non-variable and stable source of water. The use of these effluents as a supplementary water resource is recommended as a complement to other natural water resources. The ocean is at the other extreme, a vast and reliable source of water. Desalinated water from a number of sources is therefore a valuable diversification of the water resources available to a region or community. As an example, the Singapore Government has a national strategy of diversified water supply, referred to as the four national taps, including: natural surface water; imported water from Malaysia, desalinated seawater and reclaimed wastewater effluents.

2.4 The imperative to re-use water

The Department of Water Affairs has identified water re-use as an important water Reconciliation Strategy for several water management areas. A separate National Strategy for Water Re-use has been developed by the Department and is published along with the NWRS2. In many cases, desalination will be required to implement water re-use schemes.

Water re-use can technically be performed by using an indirect or a direct approach. Indirect water re-use is based on treating the used water and discharging the treated water to a natural or man-made stream, dam, aquifer, etc. before abstraction and use by a second downstream water user. Indirect re-use of water therefore introduces a natural or man-made environmental barrier between the first water user and the second water user.

Direct water re-use is based on treating the used water to a level which is fit for direct use by a second water user. The treated water is then supplied directly to the next water user without going through a natural or man-made water body such as a stream, dam or aquifer. Irrespective of the way in which water re-use is implemented, desalination may be required.

2.5 Development of seawater as an additional water resource

Coastal cities and communities have access to the oceans as a potential source of water. These communities are located at the downstream end of catchments and may be water stressed due to the upstream utilization of the available water. It is not uncommon for these coastal cities and communities to be the first to experience water stress in a water management area approaching the limits of available conventional surface and ground water sources. A number of coastal cities, communities and industries have installed or plan to implement seawater desalination projects.

Seawater desalination is always considered as one of the range of water resources available to coastal cities and communities. South Africa has not implemented large scale desalination projects and the socio-economic and environmental impacts of such projects on local communities and ecosystems must be fully understood and considered .[4]

2.6 International trade and industry standards

International trade places increasing focus on the environmental practices, specifically responsible water use at the farms and factories producing export products. As mining, industrial and agricultural operations are challenged by more stringent product and discharge standards, these facilities may introduce measures such as Zero Effluent Discharge (ZED) policies and/or require higher water quality as an input to their processes. This typically implies that effluent is recycled, with or without treatment for re-use. To mitigate a steady accumulation of salinity in such recycled water systems, it is in some cases necessary to introduce desalination to remove/bleed excess salts from the water system.

2.7 Desalination is already being implemented in South Africa and is cost-effective compared to the alternatives

Desalination is already taking place in South Africa (albeit at a small scale) and planning for future major desalination facilities is already underway. The reclamation and re-use of effluents after some form of treatment, which may include desalination, is becoming financially attractive compared to other conventional water resources development options.

3 KEY STRATEGIC CONSIDERATIONS

3.1 Water source, scale, location, energy and environmental considerations

3.1.1 The significance of source

The source of water affects how desalination is likely to be implemented, including the location, scale, type of technology employed. Seawater desalination is typically undertaken to produce potable water and the scale can vary from very small to very large depending on demand. The desalination of mine water decant may, for example, be driven by the need to reduce negative impacts on the environment and to produce a product water fit for use. The choice of technology and scale of implementation will be specific to each situation. Similarly, the re-use of municipal wastewater is dependent on the location and capacity of the wastewater plants and the use to which the reclaimed water will be put.

A strategy for desalination needs to take these diverse contexts into account.

[4]Sadhwani J. J et al. Case Studies on Environmental Impact of Seawater Desalination. 2005. Desalination. Volume 185. p 1-8.

3.1.2 Understanding the importance of scale: package versus bespoke plants

The issue of scale is particularly important. Small-scale (up to a few Ml/day) implementation of desalination may lend itself to the use of pre-designed package plants, whereas large-scale implementation (10 Ml/day and up) will typically be custom designed for each site. There is a significant difference between these two in terms of both complexity and financing requirements.

A strategy for desalination needs to differentiate between different scales of project implementation.

3.1.3 The significance of location

The relative location of the source water and the demand for water significantly influences desalination costs. Ideally, desalination projects should try to optimize costs by matching demand and supply within close geographic proximity of each other. The availability and proximity of waste heat will also potentially influence costs significantly.

3.1.4 The linkages between energy and water

Desalination technologies[5] are all relatively energy intensive as reflected below:

Desalination technology	Unit energy consumption (kWh/m^3 water)
Distillation, using multiple effect distillation technology	12-18
Distillation/evaporation using mechanical vapour compression technology	11-16
Membrane desalination of seawater (with energy recovery)	4-8
Membrane desalination of brackish water	2-4
Conventional water treatment	0.2 – 0.3
Conventional sewage treatment	0.6 – 1.0

The bulk of South African electrical power (>90%) is generated by coal fired power stations. There is therefore a direct linkage between energy (power) consumption and carbon (CO2) emissions. South Africa has committed to implement and develop renewable energy resources to deal with our increasing national carbon footprint.

Desalination treatment technologies have over time become more energy efficient. As an example, the history of Spanish seawater desalination plants reflects a progressive decrease in energy consumption from 22 kWh/m3 in 1970, to 8 kWh/m3 in 1990 to a current 4 kWhr/m^3 (with the plants now incorporating energy recovery devices).[6] Energy recovery is an important consideration in desalination processes. Energy may be recovered in distillation processes through heat recovery from the condensate as well as from the hot brine, while in reverse osmosis processes energy may be recovered from the pressurized brine stream.

Some desalination projects are now linked to the development of renewable energy resources to offset the carbon footprint of energy intensive plants. Globally, the more affordable renewable energy sources include wind and biomass with solar, tidal and wave energy sources more expensive to develop. South Africa has potential to develop a wide range of renewable energy resources.

The sustainability of desalination projects can be advanced if such projects are implemented in a carbon neutral manner. This can be achieved by developing desalination projects in parallel with nuclear energy and renewable energy projects. This approach will also contribute towards a better mix of energy resources in South Africa.

3.1.5 Waste disposal

Desalination treatment processes remove ionic species from a feed water source and concentrate these ionic species into a smaller volume. The different desalination technologies may vary in the way this takes place, but in all cases a waste residue stream is generated, which contains the ionic species and other compounds removed from the feed water. The types of waste residue generated depend on the specific desalination treatment technology – See Appendix 1.

The sludge and brine waste streams could have a hazardous waste rating in terms of the Minimum Requirements for Handling, Classification and Disposal of Hazardous Waste (DWAF, 1998) depending on the waste composition. Some of these desalination waste streams may therefore require special handling and disposal techniques.

Coastal seawater desalination projects are typically based on the return of the brine stream back to the ocean. The ocean has assimilative capacity for brine and hyper saline solutions, but consideration must be given to the diversity and sensitivity of ocean habitats in implementing such projects.

[5]Isabel Escobor et al. Sustainable Water for the Future – Water Recycling versus Desalination. Elsevier Publishers. 2010.

[6]Sadhwani J.J & JM Veza. Desalination and Energy Consumption in Canary Islands. Desalination Volume 221. 2008.

Inland desalination projects have fewer waste brine and sludge disposal options, which are limited to:

- Evaporation pans and ponds
- Thermal evaporation to produce salt crystals, which still require handling and disposal
- Deep well injection requires suitable geological formations, which are not widely available in South Africa
- Deep underground mining compartments isolated from any exploitable groundwater aquifers
- Further treatment to recover some of the salts in the brine stream, which may have commercial value

The disposal of desalination waste streams for inland projects remains a challenge and may place a constraint on the development of such projects.[7]

Research and development projects are currently undertaken to investigate the recovery of useful and saleable products from desalination waste sludges and brines. Some success has been achieved by the use of gypsum for building industry products. Several other investigations and demonstration projects are underway.[8] Few of the projects have reached a commercial scale of application, based on proven technology.

One of the challenges is to adequately account for long term cost and liability of waste sludge and brine handling and disposal, especially for inland locations.

3.2. Technology considerations

3.2.1 Locally or internationally sourced technology?

South Africa is not currently well positioned in terms of well-established local knowledge, skills and implementation related to desalination. A limited number of large desalination projects have been constructed, mainly by the mining industry. The water industry is, however, well established and has the capacity to respond to the need for an increasing number and more complex desalination projects. It is important to further grow and commercialise local desalination technologies and to maximize the local content of desalination projects. South Africa has the potential to further develop and export technology related to the treatment of mine water and industrial effluents. This is an area worthy of research and development and is a specific focus area that should attract adequate funding. Consideration must be given to establish centre(s) of excellence at one or more academic institutions. The core of skilled and experienced people to establish such centres of excellence already exist.

The commercialisation of South African development and/or enhanced desalination technologies in identified niche markets (such as mining and industrial process water, mobile and packaged desalination units), is a specific objective of this strategy. This will require collaboration between research and development agencies, water services authorities, water services providers, implementation contractors and financial institutions. A recent report by Frost and Sullivan[9] indicated that the South African desalination services and equipment market could grow to an annual turnover of approximately R 500 million by 2013.

3.3 Financing considerations

3.3.1 Recovering the costs of desalination

The cost of desalination projects will have to be recovered from the water users in accordance with the principles of the National Water Pricing Strategy. A desalination project will typically be one of several schemes to supply water to a region, city of community. The water tariff must reflect the cost of the total water supply system, including the desalination project(s) and the specific users of the desalinated water must not be charged a differential rate or tariff.

3.3.2 Understanding future cost risks

The operating costs of desalination are typically higher than conventional water treatment technologies. In addition, desalination costs are sensitive to changes in future energy costs, the cost of membranes, the cost of chemicals and finance costs. To the extent that finance is raised outside of South Africa, desalination costs may be subject to foreign exchange risks as well. In evaluating desalination options, it is important that these uncertainties are properly understood and an appropriate risk assessment and analysis is undertaken.

3.3.3 Financing desalination projects

Large-scale desalination projects lend themselves to project-finance, that is, the capital costs can be financed through loans on the basis of future revenue streams. This approach is already used in the water sector for large water resource infrastructure projects, such as the recently completed Berg River Dam. Two favourable options present themselves – a design-build model, with a separate operating arrangement (such as that used by the Trans Caledon Transfer Authority [TCTA] for Berg River Dam) or a design-build-operate model which is common for large-scale desalination projects internationally. In the first case, a public body such as the TCTA or another public body raises the finance, contracts the private sector to design and build the plant, and then separately arranges for the operation of the plant. In the second case, a private company raises the finance, builds the plant and operates it in terms of an off-take agreement with the water purchaser. In both cases, scarce public financial resources are not necessary to fund the plant and this offers a significant advantage.

[7]Previous research by the Water Research Commission (An Investigation of Innovative Approaches to Brine Handling, Project K5/1669/3, 2008) prepared estimates of the amount of desalination treatment waste which could be produced by mine water and industrial effluent treatment. The current and projected desalination wastes are expected to be generated by mainly the pulp and paper, petrochemical, power generation and mining sectors. Brine and other desalination waste generation is expected to increase substantially in future, as the number of desalination projects multiply.

[8]to inter alia recover: Gypsum; Sulphur; Ammonium sulphate, feedstock to the fertiliser industry; Sodium sulphate, feedstock to the pulp and paper industry; Calcium nitrate, feedstock to the explosives industry; Magnesium hydroxide, Magnesium carbonate.

[9]Frost and Sullivan. South African Desalination Plant Markets. Report No M63A-15. December 2010.

3.4 Regulatory approvals

A number of laws and associated regulations apply to desalination projects. The most important being the following:

- National Water Act, Act 36 of 1998
- Mineral and Petroleum Resources Development Act, Act 28 of 2002
- National Environmental Management Act, Act 107 of 1998
- National Environmental Management: Waste Act, Act 59 of 2008
- Water Services Act, Act 108 of 1997
- National Environmental Management: Integrated Coastal Management Act, Act 24 of 2008
- National Seashores Act, Act 21 of 1935

The regulatory requirements for the licensing and permitting of desalination facilities vary considerable depending on the location and scope of the facility. The multiple laws and associated regulations applicable to desalination projects place a constraint on the stream lined and expedited implementation of desalination projects. The Department of Water Affairs must play a lead role in promoting an integrated and streamlined approach to obtaining regulatory authorisation of desalination projects.

The Department must, in collaboration with the Department of Environmental Affairs (DEA) and other government departments develop guidelines on the integrated approach to be followed in licensing and permitting of desalination projects. Some work in this regard has already been done and guidelines for the integrated regulatory approval of specifically seawater desalination projects are urgently required.

3.5 Public acceptance

Desalination of water has many societal and community benefits as additional water supply, but depending on the source of feed water, may still encounter scepticism and even water user opposition. Desalination is a relatively new concept to South African water utilities and water users. Perceptions are already formed about desalination, ranging from a sophisticated technology which cannot be supported in a developing country to a very costly water treatment process which will drive up the cost of water to the consumer. It is important to inform and educate the public and stakeholders to allow constructive and informed participation in decisions related to desalination projects.
Public acceptance is partly addressed in the environmental approval processes (see regulatory approvals above) but needs to be supplemented with a proactive communications initiative to educate the public and stakeholders.

3.6 Implementation considerations

3.6.1 Critical factors for success

Desalination projects require implementation, operation and maintenance of sophisticated technologies. The success of such schemes relies on many factors, including:

- Appropriate planning and procurement approaches
- Access to robust and reliable technology
- Competent operations and maintenance
- National standards and guidelines
- Trusted and reliable implementation agencies
- Public acceptance and support

Desalination technologies are well proven and many such projects are successfully implemented and operated internationally. Access to global desalination technologies is available, but the local content of desalination projects should be maximised.

3.6.2 Public and private cooperation in provision of desalination solutions

In South Africa, it is normal practice for the public sector to contract out the design and construction of a new water treatment facility to the private sector, and then to assume responsibility for the operation of the treatment works once it has been commissioned. In the case of desalination, especially large-scale desalination of water intended for potable use, there is a strong case to be made to extend the role of the private sector to the operation and maintenance of the facility. This is because the technology is new and unfamiliar in South Africa, local capacity and skills to operate major desalination facilities do not exist in South Africa and the consequences of failure are significant. This is common practice internationally, where private firms are contracted on the basis of a design-build-operate contract. In the case of small package and community plants, operation and maintenance requirements are much more straight forward and the public sector can operate these facilities with some support from the private sector. There is also a strong case to be made for the involvement of the private sector in the financing and management of facilities related to industrial and mining water and effluent. This may require regulatory oversight and wider stakeholder consultation to ensure public trust and social benefit to the community.

3.6.3 Capacity of implementation institutions/agencies

It is likely that desalination will be required in future in a variety of locations in South Africa. There is a choice to be made on a decentralized strategy in terms of which local institutions/agencies implement desalination projects themselves, with some assistance and guidance from DWA, and the development of one or more national centres of excellence. There are significant advantages in developing a single centre of excellence for implementing desalination projects, especially for large-scale complex projects. One candidate for large desalination project implementation is the Trans Caledon Transfer Authority (TCTA).

Large metropolitan municipalities and water boards, as well as, those capable municipalities that have been delegated authority as the Water Services Authority under the Water Services Act, (Act No of 108: 1997) could also develop the capacity to implement desalination projects provided attention is given to:

- Development of capacity in terms of expertise, exposure and implementation of such projects
- Dealing with cumbersome and time consuming National Treasury PPP regulations
- Implementing Section 78 of the NWA which could increase project time periods and risks

A DESALINATION STRATEGY FOR SOUTH AFRICA

4.1 Successful implementation of desalination is critical to our water future

National government recognizes that desalination will play a critical role in South Africa's future water security. The Department of Water Affairs will ensure that desalination is properly considered as an option for meeting future water requirements in its integrated water resource planning processes, and will actively promote and support the development and implementation of desalination projects where these projects compare favourably to other alternative options, taking into account the benefits of diversity of water supply in the context of increased climate change risk.

4.2 Integrating energy and water planning

There are strong relationships between the choice of future electricity generation options, the implications for the location water requirements and the potential and cost-effectiveness of desalination. National government, through the National Planning Commission (NPC), and together with DWA, the Department of Energy (DOE), the Department of Public Enterprises (DPE) and Eskom, will ensure strong integration of the medium and long term energy and water planning. Particular attention will be paid to the potential for desalination of seawater for coastal cities in relation to a possible expansion of nuclear power generation, vis-à-vis other power generation alternatives and their implications for water planning.

4.3 Water quality regulations

Desalination treatment and use of desalinated water may in some instances involve re-use of effluents. The desalination of brackish water, mine water, industrial effluents, municipal treated effluents and seawater introduces new water quality issues. South African standards on reclaimed and re-use water quality are required for different categories of water use. The re-use water standards must be integrated with the other national guidelines and standards on water quality. Water quality issues pertaining to water re-use will be addressed in DWA's National Strategy for Water Re-use.

4.4 Streamlining regulatory approval processes

DWA will work with DEA and other relevant departments to develop an integrated and more streamlined and time-effective approach to regulatory approval for the desalination of water. This initiative requires a specific focus on seawater desalination, where current regulatory approval processes are unclear. DWA will develop a guideline on an integrated regulatory approval process. This guideline will address:

- The parallel and integrated consideration and approval of licences and permits in terms of the different Acts and associated regulations.
- The appropriate sequencing and scheduling of parallel authorization processes.
- The potential for a lead agent, being the Department of Water Affairs, to coordinate and expedite the different regulatory authorization processes.
- The need of a single public participation and stakeholder engagement process to support all the different authorization processes.

4.5 Research and development

DWA will work with the Water Research Commission (WRC), the Department of Science and technology (DST) and the Department of Trade and Industry (DTI) to support the development of desalination technologies where South Africa has comparative advantages, particularly in desalination processes related to mining and industry, including investigating the establishment of a centre of expertise and excellence at one or more universities. The objective of the research and development will be to develop technologies and processes that can be commercialised and applied to the different scales of desalination projects.

Particular attention will be paid to the following areas:

- Acid mine drainage and other saline mine waters
- Mining and industrial process effluents
- Investigating the technical and environmental feasibility and providing guidelines for the establishment of saline surface pans or lakes as regional facilities for brine disposal
- Investigating the technical and environmental feasibility and providing guidelines for brine disposal to deep underground mining voids and workings
- Investigating the technical and financial feasibility of recovering useful and saleable products from desalination waste streams
- Supporting research into and the development of more energy efficient desalination technologies

4.6 Financing desalination projects

Water infrastructure in South Africa is mainly funded by a combination of loans raised on the basis of user charges (water tariffs) and government grants (primarily through the municipal infrastructure grants and regional bulk infrastructure grants). At present there is little private equity and investment in water infrastructure.

Desalination projects, especially large scale projects, lend themselves to loan financing due to the secure nature of the revenue streams that can be generated from the sale of desalinated water. In an environment where government grants and borrowing capability are constrained, the option of using privately raised loan finance (that is, project finance) for the development of large-scale desalination facilities will be explored. Typically this can be achieved through design-build-operate type contracts (or variations of this type of contract) with the private sector.

DWA will also investigate the possible use of revenues raised through the Waste Discharge Charge System (once implemented) to fund or contribute towards the financing of desalination projects.

4.7 Who should implement desalination projects?

Trusted and capable water institutions are required to successfully plan and implement desalination projects. Such water institutions must also have the capability and credibility to operate and maintain desalination projects. The public trust in such institutions must be high, since these projects may impact negatively on water users if not properly operated and maintained.

Large metropolitan municipalities[10] and water boards with a proven track record in the implementation of large water treatment projects must be positioned to implement desalination projects.

Selected local municipalities and district municipalities with a threshold of engineering operations and project management capacity on complicated water resource development and water treatment schemes may also be considered to implement desalination projects.

Mines and industry already have the capacity, knowledge and expertise to implement desalination projects. Public sector institutions/agencies must leverage on the South African private sector ability to implement such projects.

Careful consideration must be given to the mobilisation of private sector skills, experience and capacity in the implementation of desalination projects. This is especially the case for large-scale desalination installations. In the case of mine water, it makes sense to involve the private sector and to promote private sector participation in these projects

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4.8 Implementing large-scale sea water desalination projects

DWA will consider developing expertise for the implementation of large scale desalination projects, aim to maximize the use of project-finance in these projects (off-budget loan finance), ensure capable, credible, reliable and competitive technology suppliers are used, oversee the development of a standard contracting model for these projects and improve and optimize the contracting model over time, and ensure reliable operating arrangements.

4.9 Desalinating and treating acid mine water

DWA will work with DST, DTI, WRC and the private sector with the aim of South Africa becoming an international leader in the field of the treatment and desalination of acid mine water and related mining process waters, through applied research & investing in local technology. Treatment processes will seek to maximize the benefits from extracting useful byproducts from the waste streams. The use of private sector finance and skills will be promoted, while protecting the public interest. Regional economies of scale will be sought where possible. Public-private partnerships will be developed to find and implement solutions.

4.10 Development of skills and local capacity

Competent project management, engineering, operations and maintenance people must be available to implement desalination projects. This is a relatively new technological field in South Africa and professional and trade organisations, academic and training institutions must incorporate desalination science and technology into their curricula. Training of process operations staff, mechanical, electrical and instrumentation maintenance staff in desalination technology and plant is required. Desalination plants require a substantial capital investment and competent and skilled operations and maintenance personnel are required to protect and extend the life of these assets.

4.11 Increasing public awareness and acceptance

DWA will:

- Disseminate information on water desalination to the public, and will prepare and distribute desalination information packs at water events such as the National Water Week
- Incorporate desalination in general water use awareness campaigns
- Motivate water institutions and professional and trade associations to disseminate information on desalination and to develop skills relevant to desalination projects
- Encourage desalination project developers to make desalination related education and information materials available to the public

4.12 Developing guidelines

The Department will develop further guidelines for the implementation of desalination projects as necessary and appropriate. These guidelines will address relevant topics, such as:

- Selection of appropriate technology and equipment
- Capital and capital replacement costs
- Operations and maintenance costs
- Management, operations and maintenance staffing and resources requirements
- Financing of projects
- Tariff development and implementation
- Public and consumer communications and outreach programmes

[10]Du Plessis J. A et al., A Desalination Guide for South African Municipal Engineers. 2006. Department of Water Affairs and Forestry and Water Research Commission. Report No. WRC TT 266/06.

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APPENDIX 1: DESALINATION TECHNOLOGIES AND ASSOCIATED WASTE STREAMS

Membrane Based Desalination Technologies

Membrane based desalination treatment processes are based on the use of a semi-permeable membrane, which selectively allows water to pass through the membrane, but retains the salt species. The basic concept of a membrane separation system is shown schematically below:

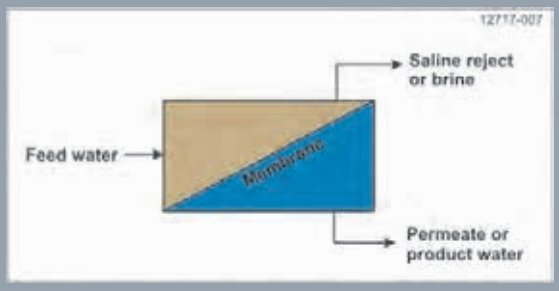


Figure 2: Concept of Membrane based Desalination Treatment

Pressure is typically applied to the feed water to overcome the osmotic pressure of the saline or brackish feed water.

A variety of membrane materials are used with the most common ones being cellulose acetate and aromatic polyamide in different thin film composite designs.

The successful operation and performance of membrane desalination processes are very sensitive to fouling and blockage of the membrane surfaces by:

- Organic gel formation
- Inorganic precipitation
- Colloidal accumulations
- Biological growth
- Membrane degradation

Membrane desalination treatment processes are very dependent on efficient pre-treatment to reduce the risk of membrane fouling and damage. Membrane cleaning and regeneration systems also help to extend the length of production runs and prolong the life of membranes. The product water is the membrane permeate, while the membrane reject stream contains a concentrated brine solution.

Ion Exchange Based Desalination Technologies

Ion exchange (IX) desalination processes are based on the use of ion specific resins, which typically exchange:

- A cation (Ca^{2+}, Na^{+}, etc) for a proton, H^{+}
- An anion (Cl^{-}, SO_4^{2-}, etc) for a hydroxide OH^{-}

This process then removes ionic species from the water and produces a relatively salt free product water as shown schematically below:

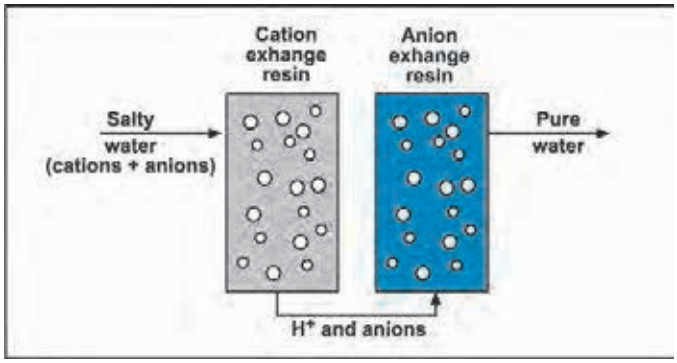


Figure 3: Concept of Ion Exchange based Desalination Treatment

The IX technology has been advanced by the development of ion specific exchange resins. A target ionic species (for example Ca^{2+}, Mg^{2+}) can be removed without substantial removal of other non-target ionic species.

All IX technologies require regeneration of the ion exchange resins. Once the ion exchange resin has been loaded to capacity (which is finite) by the target ionic species, a regeneration process is initiated. Typically an acid is utilized to regenerate cation selective resins, displacing the cations bound to the resin by protons. An alkali is typically utilized to regenerate anion selective resins, displacing the anion bound to the resin by hydroxide.

IX processes therefore, produce a high salinity waste product, typically in the form of brine. These regeneration processes use relatively large amounts of regeneration chemicals and the salinity load of the waste brine is higher than the salinity load removed from the feed water.

The typical applications of IX type processes have been focused on:
- Brackish water desalination
- Polishing of feed water to produce a very low salinity product water (such as boiler feed water)
- Softening of feed water to specifically remove cations such as Ca^{2+}, Mg^{2+} with a scaling potential

Precipitation Based Desalination Technologies

Precipitation type desalination processes are based on the selective removal of specific ionic species (such as SO_4^{2-}) by addition of a reagent, which reduces the solubility of the target ionic species. The reagent may be a high value product and may have to be recovered from the precipitated salt for economic reasons. The concept of a precipitation type desalination process is shown schematically as follows:

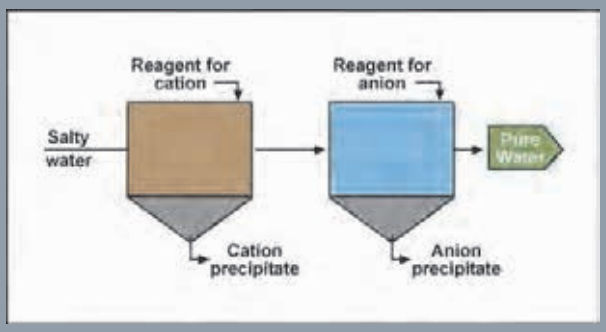


Figure 4: Concept of Precipitation based Desalination Treatment

The precipitation concept finds practical application where a specific target ionic species is to be removed. The commercial application of this concept mainly related to hardness removal (using lime/soda ash) and to sulphate removal (using $A\ell(OH)_3$ or $BaCO_3$). The commercial success of some of these precipitation processes is sensitive to the ability to recover and recycle the precipitating reagent, such as $BaCO_3$.

The precipitation type processes typically produce sludge (ionic species precipitates) as a waste product.

The different desalination treatment technologies find different niche applications, depending on:
- Feed saline/brackish water composition
- Target product water quality
- Management and disposal of waste products such as sludge and brine

Waste streams

Membrane treatment processes produce concentrated waste saline solutions or brines. If the saturation limit of some salt species is exceeded, these salts would precipitate and form sludge as part of the brine stream. The salt load associated with the brine is similar to the salt load removed from the feed water. The brine production is also dependant on the feed water and the typical brine production for different feed waters is summarised as follows:
- Seawater brine production = 50 – 60% of feed water flow
- Brackish water brine production for a high Na-Cℓ content feed water = 5-10% of feed water flow
- Brackish water brine production for a high Ca-Mg-SO_4 content feed water = 1-3% of feed water flow

Ion exchange treatment processes produce a concentrated saline waste in the form of a regenerant stream. The salt load of the IX regenerant stream is higher than the salt load removed from the feed water due to the addition of regenerant chemicals. The waste regenerant composition depends on the feed water ionic makeup and the specific regenerant chemicals used. The IX regenerant waste stream is relatively small, but highly concentrated. The waste stream is typically 1-5% of the feed water volume.

Precipitation desalination treatment processes produce a sludge stream as residue and typically not a brine or hyper saline solution. The waste sludge streams have more flexibility in terms of handling and disposal.

Annexure D
National Strategy for Water re-use

June
2011

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Table of Contents

INTRODUCTION

South Africa has limited fresh water resources and has been defined as water stressed by International standards[1].

The re-use of water in South Africa accounts for approximately 14% of total water use, and return flows account for a large part of water available for use from some of the important river systems[2]. The National Water Resources Strategy (First Edition) identifies water re-use as one of a number of important strategies to balance water availability with water requirements in future and the extent of water re-use in South Africa is very likely to increase substantially over time. There is an associated risk that water re-use is unplanned, unregulated and/or results in unintended or undesirable consequences.

The re-use of water is widely practiced in the world, both in developed and emerging economies. Many countries have developed water re-use policies and associated laws and regulations. Water re-use internationally contributes to reconcile the gap between water availability and water needs in such countries as the United States of America, Spain, Australia, Israel and China.

Within the above context, this document provides a strategy for a considered approach to implementation of water re-use projects that is consistent with the National Water Resource Strategy[3] and national water policy and legislation.

1.1 Defining water re-use

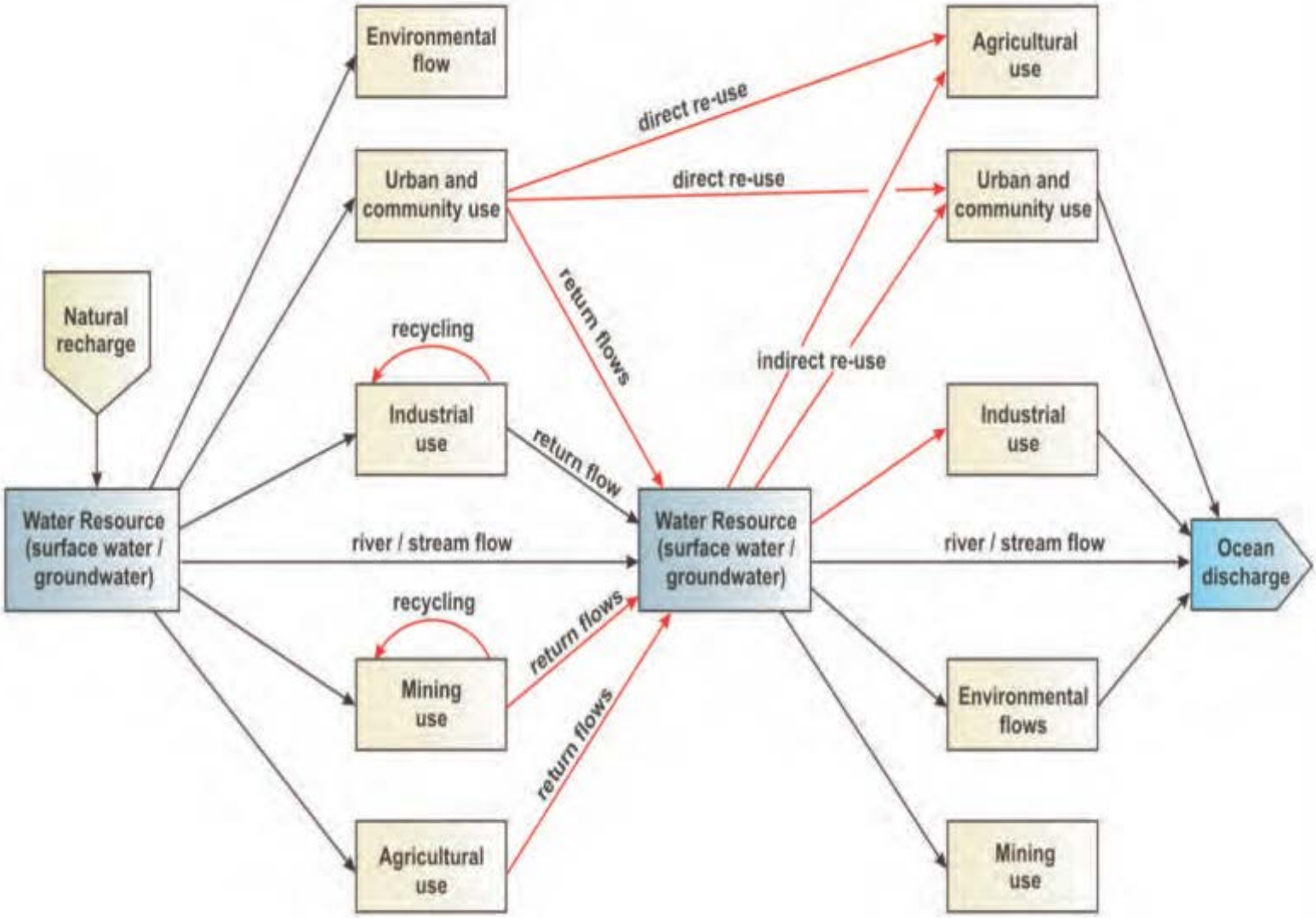
Water re-use can be direct or indirect, intentional or unintentional, planned or unplanned, local, regional or national in terms of location, scale and significance. Water re-use may involve various kinds of treatment (or not) and the reclaimed water may be used for a variety of purposes. These different kinds of water re-use have different implications for a re-use strategy. It is therefore important to be precise in the use of terminology. Definitions of commonly used terms are given in **Table 1.**

Figure 1 illustrates how water can be re-used and recycled. This illustration does not cover all possible methods of water re-use, but is only intended to demonstrate the concepts involved in water re-use and water recycling.

Table 1: Water re-use terminology

[1]Water Re-use, An International Survey of Current Practice, Issues and Needs. Editors Blanca Jimenez and Takashi Asano. IWA Publishing. 2008.
[2]Integrated Water Resource Planning for South Africa. A Situation Analysis 2010. Department of Water Affairs. Report No RSA 000/00/12910.
[3]National Water Resources Strategy, Department of Water Affairs and Forestry, First Edition, September 2004.

Term	Definition
Water re-use	Utilization of treated or untreated wastewater for a process other than the one that generated it, i.e. it involves a change of user. For instance, the re-use of municipal wastewater for agricultural irrigation.
Water recycling	Utilization of treated or untreated wastewater for the same process that generated it, i.e. it does not involve a change of user. For instance, recycling the effluents in a pulp and paper mill.
Direct re-use	Re-use of treated or untreated wastewater by directly transferring it from the site where it is produced to a different/separate facility for the next use.
First water use	Water coming from a fresh water source receiving no identifiable upstream wastewater discharges.
Indirect re-use	Re-use of treated or untreated wastewater after it has been discharged into a natural surface water or groundwater body, from which water is taken for further use.
Intentional or planned re-use	Use of treated or untreated wastewater as part of a planned project. It is always performed intentionally, consciously and using reclaimed water for a specific user.
Unplanned or incidental re-use	Subsequent use of treated or untreated wastewater after it has been discharged into a surface water or groundwater body from which water is taken for drinking purposes or another use. Initially, it always occurs as a subconscious activity; with time it might occur consciously but not as part of a planned project in which wastewater is properly treated and water quality monitored for the specific water use purpose.
Reclaimed water	Wastewater that has been treated to a level that is suitable for sustainable and safe re-use.
Return flows	Treated and/or untreated wastewater that is discharged to a natural surface water or groundwater body after use.
Wastewater	Water derived from any of a number of uses of water and typically containing residual pollutants associated with the use of the water.
Grey water	Wastewater derived from the domestic and household use of water for washing, laundry, cleaning, food preparation etc. Grey water does not contain faecal matter.
Black water	Wastewater containing faecal matter and urine associated with water use in toilets and urinals.



Note: This figure does not show all possible water use, re-use and recycle, but demonstrates the concepts

Figure 1: Illustration of different ways that water can be re-used and re-cycled

2

UNDERSTANDING RE-USE IN THE CONTEXT OF WATER SUPPLY

There are essentially three generic sources of 'used' water associated with different scales of water re-use:

- At a micro-level, the water that has been used by a household, a business, an institution or industrial facility, a power station, a farm or a mine. The key feature is that this used water is available at a specific and local geographic location. The quantity and quality of water available for re-use will depend on how it has been used and if there is any local (on-site) treatment or not.
- At a community or facility level, where wastewater has been collected from a group of users (typically within a natural drainage basin), and typically through a sewer network. In this case, the used water is available at the discharge point of the treatment facility at a quality that is dependent on both the characteristics of the inflow to the treatment facility as well as the treatment technology used and its effectiveness (both in terms of design and operational performance).

- At a river system level, where used water (treated and untreated) has been discharged (or found its way) back into the river system. In this case, the used water is blended with the 'fresh' water in the river system. The quality of the river water will depend on the quality and quantity of the return flows, the state of the receiving water body and its assimilative capacity, and the ratio of fresh water flows to return flows (the dilution effect).

At a river system level, it is estimated that approximately 1 800 million m3 per annum of water flowing in our rivers is return flow, that is used water, accounting for 14% of the total available water in South Africa. At the treatment facility level, South Africa has in excess of 1 000 municipal wastewater treatment works, discharging approximately 2 100 million m3 per annum of treated effluent, back to the river systems[4]. At the "micro level", the availability of South Africa's water for re-use may be broadly categorized and aggregated into different industrial, mining, power generation and agricultural sources[5]:

Mines, in addition to using fresh and re-using water, may also 'generate' water. This occurs through the filling of mine cavities and the need to pump this water, or the natural decanting of this water where pumping does not take place. This water is referred to as mine decant or mine drainage. This water may be acidic, saline and may contain heavy metals. The mine water typically needs to be treated before it can be re-used

UNDERSTANDING THE NEED FOR WATER RE-USE

3.1 Key drivers affecting water re-use choices

There are five key considerations that affect choices related to water re-use as an option for water supply and augmentation:

- Water quality and security of supply
- Water treatment technology
- Cost relative to other water supply alternatives
- Social and cultural perceptions
- Environmental considerations

Although these are likely to be inter-related in practice, it is useful to discuss each in turn.

3.1.1 Water quality and security of supply

The cost of water is strongly related to the source of water, the required water quality and the associated treatment requirements (for both supply and discharge). Where water quality requirements are relatively low or where wastewater discharge costs are high, the re-use of water is likely to be more attractive.

Water quality as it relates to public health is important in considering water re-use as a water supply option. Any real or even perceived threat to public health would be considered a fatal flaw.

The re-use of water may increase the security of supply for specific users and may therefore be attractive in these cases, even where the cost exceeds alternative supplies. Note that it is not necessarily the case that increased water re-use increases the security of supply for an overall water supply system.

3.1.2 Water treatment technologies

The choice of treatment technology is a function of both the nature of the pollutants in the water and the required quality of the re-use water. An overview of applicable treatment technologies is given in **Table 2.**

The best practice in water re-use projects applies the multiple barrier approach to the control and removal of pollutants. This implies that in the sourcing, treatment and distribution of reclaimed water several control, technological and management barriers are set up to achieve a high level of assurance with respect to pollutants removal and producing a reclaimed water fit for use and safe for human consumption.

[4]Wastewater Treatment in South Africa: From Crisis to Compliance. Water Research Commission. Report No. 8001/8295/3/P, August 2006.
[5]A First Order Inventory of Water Use and Effluent Production by South African Industrial, Mining and Energy Generation Sectors. Water Research Commission.
Report No. 1547/1/10, April 2010.

Table 2: Applicable water treatment technologies for water re-use

Category of Pollutants	Applicable Technologies
Macro-organics, COD and BOD5	• Biological treatment (activated sludge, trickling filtration, fixed film reactors, membrane bioreactors) • Chemical coagulation/flocculation and clarification
Particulate and suspended solids	• Chemical coagulation/flocculation and clarification • Granular media filtration • Membrane filtration
Nutrients – Nitrogen	• Biological nitrogen removal (nitrification/denitrification) • Air stripping (ammonia) • Chemical coagulation/flocculation and solids separation
Nutrients – Phosphorus	• Biological phosphorous removal (enhanced biological phosphorus uptake) • Chemical precipitation (typically metal salt addition) • Chemical precipitation (packed bed reactors)
Microbiological Agents: •Bacteria •Viruses •Parasites	• Membrane filtration • Chemical disinfection (chlorine, bromine compounds etc.) • Ultra Violet (UV) radiation
Salinity, inorganic salts	• Precipitation • Ion exchange • Membrane desalination (nanofiltration /reverse osmosis)
Metals	• Precipitation • Chemical adsorption • Membrane separation
Micro-organics: •Volatile Organics •Pesticides •Pharmaceuticals •Endocrine Disruptors	• Advanced oxidation (H2O2/UV) • Adsorption by activated carbon (granular/powder) • Membrane separation (nanofiltration /reverse osmosis) • Biologically enhanced adsorption (BAC)
Disinfection byproducts	• Modify disinfection agent in upstream processes • Advanced oxidation • Adsorption by activated carbon (PAC/GAC) • Membrane separation (nanofiltration /reverse osmosis)
Radionuclides	• Precipitation • Chemically enhanced adsorption • Membrane separation (nanofiltration /reverse osmosis)

The wastewater and effluent treatment technologies for re-use applications are generally proven for South African conditions. A local knowledge base exists to plan, design, construct, operate and maintain a wide range of treatment technologies. However, some of the more sophisticated technologies such as advanced oxidation, membrane desalination etc. have been applied to a limited number of local projects. The South African water industry will need to grow capacity to confidently implement some of the more advanced water re-use technologies.

3.1.3 Cost considerations

Where water re-use is more cost-effective compared to other alternatives (such as reducing water requirements, securing a fresh water supply or desalinating sea water), then water re-use becomes an attractive choice provided that the quality of water can meet the necessary requirements and there are not any important cultural or social objections to the use of this water.

Costs are affected primarily by water quality requirements (related to both supply and discharge and the associated treatment requirements) and the relative geographical locations of water supply and needs. As supply costs increase and with the introduction of waste discharge charges, the cost of re-using water is becoming increasingly competitive with the traditional supply alternatives and this will be a key driver for increasing re-use of water in future[6].

The typical increasing cost of different water sources is reflected conceptually on **Figure 2.** Water re-use must be considered as one of several options to augment water supply to a city, industry or mine, once the conventional fresh water resources are fully developed or the cost of water re-use becomes comparable to development of conventional water sources.

The economic value/cost of water must also be seen in the broader context of affordability, reliability and responsible use of a limited resource.

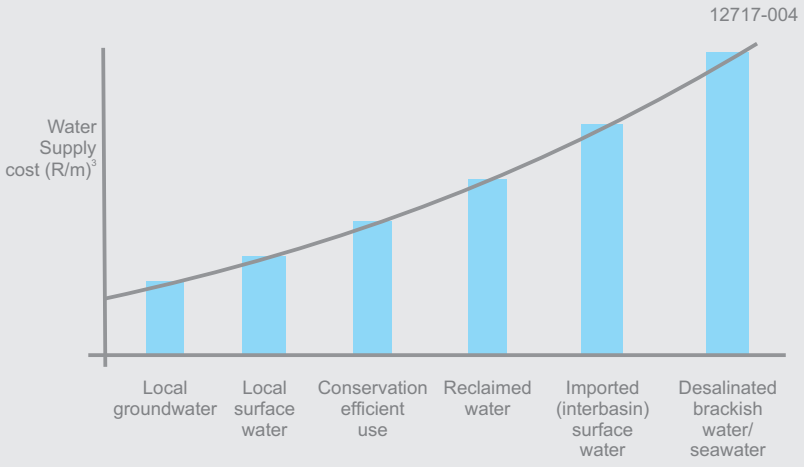


Figure 2: Comparative cost of different water sources

3.1.4 Social and cultural perceptions

Public perceptions and cultural taboos may create obstacles to certain water re-use applications. The two most important of these relate to the re-use of suitably treated municipal wastewater (comprising domestic sewage) for irrigation of food crops and for potable water supply. People attach religious, cultural and aesthetic values to water and any water re-use project must remain sensitive to these values[7].

3.1.5 Environmental considerations

Receiving water quality objectives (related to the actual and desired environmental status of a water resource) may affect abstraction rights and volumes, discharge standards, waste discharge charges and associated rights and obligations to return used water to a water system. These will ultimately affect the relative costs and benefits of re-use compared to other alternatives.

Re-use of water will typically have positive environmental benefits, specifically on the water environment through protection of aquatic ecosystems by not having to abstract more water from a natural source, and avoiding degradation of natural waters by not discharging wastewater, but rather using reclaimed water. Water re-use projects may, however, still have an environmental footprint and energy usage depending on the water reclamation technologies used. Water re-use must therefore be evaluated in the context of other water supply and water augmentation options with consideration of environmental impacts, carbon footprint, ecological footprint and energy usage.

Wastewater treatment to produce reclaimed water fit for re-use typically produces a waste stream. The handling and disposal of waste (such as brine from a mine water reclamation plant) will typically have environmental impacts. The potential exists and should be actively researched and developed to extract useful products and energy from such waste.

3.2 The need for water re-use by sector

3.2.1 Agricultural sector

Even though the agricultural sector uses about 7 680 million m^3 per annum (accounting for about 60% of total water use in South Africa), only a small proportion of irrigated agriculture directly uses treated wastewater. In contrast to this, Israel has a strategic objective to collect and treat all of its domestic wastewater for re-use in agriculture.

[6]Assessment of Ultimate Potential and Future Marginal Cost of Water Resources in South Africa. Department of Water Affairs. Report No. PRSA 000/00/12610, September 2010.
[7]Religious, Philosophical and Environmentalist Perspectives on Potable Wastewater Re-use in Durban, South Africa. Wilson Z and Pfaff B. Pollution Research Group, School of Development Studies. University of KwaZulu-Natal.

Therefore considerable potential exists to substantially expand the use of treated wastewater for irrigation purposes in South Africa. This will bring many benefits. Irrigation is often labour intensive and expanding the area under irrigation may create jobs. Wastewater return flows are typically available close to urban areas and thus close to urban markets for agricultural produce, provided suitable land is available for irrigation. Treated wastewater can substitute for freshwater, thus making more freshwater available for other uses[8].

Any such re-use of water by agriculture will have to be balanced by the competing other requirements and historical allocations of water in the specific water management area.

3.2.2 Municipal sector - non-potable water

The main source of water for re-use in municipal (urban) areas is wastewater from municipal treatment works. This typically comprises a mix of domestic sewage and other wastewater. Other sources of water for re-use include grey water (usually available at the household/water user level only) and industrial effluents.

The main potential uses of treated wastewater from municipal wastewater treatment works is for the irrigation of public open spaces (parks etc.) sports fields (municipal, schools and clubs), golf courses and cooling (related to industry and power generation). The return flows from wastewater treatment works can also be important for urban water systems (rivers, lakes, dams and wetlands). Treated wastewater and/or grey water can also be used for fire fighting, toilet flushing, cooling systems, street cleaning, dust control and a variety of applications that do not require potable water.

Of the total volume of municipal wastewater treated, it is estimated that only a small fraction is re-used, most of it is for the irrigation of public open spaces, sports fields, golf courses and cooling systems. In the past, the urban/municipal re-use of treated wastewater was not actively promoted due to the cost of such systems and the potential public health risks. Some re-use of water, for example in the irrigation of recreational areas and golf courses may be in competition with other essential water uses.

3.2.3 Municipal sector - potable water

Used water can be treated to a standard fit for domestic use (drinking purposes). Treated water can be supplied directly to households (direct re-use) or be discharged back to the (fresh) water resource where it is blended with other water and subsequently abstracted, treated and distributed for use (indirect re-use).

There are many potable water re-use schemes in operation in the world. The majority of these schemes are based on an indirect re-use approach. Indirect water re-use for potable purposes is well established in South Africa. It is common for a treated wastewater effluent to be discharged to a river system and for water to be abstracted downstream of this discharge point and to be treated and used for drinking water. The direct re-use of used water for potable purposes has not been implemented in South Africa, but has been successfully implemented in Windhoek, Namibia, since the 1970's[9].

The main concerns related to both the direct and indirect re-use of water for potable purposes include the following: the presence of pollutants such as pharmaceuticals, health care products, pesticides, industrial chemicals, heavy metals etc. in municipal wastewater and industrial effluents that may be difficult or costly to treat adequately, the associated risks in terms of the ability to design and manage treatment processes with a suitable level of confidence and to predict the public health impacts of re-using water for drinking purposes. Public perceptions and acceptance of direct and indirect re-use of water for drinking purposes are also challenges and in this case sophisticated and reliable technical and management systems will be required.

3.2.4 Industrial sector

The re-use of water is already widely implemented by water intensive industries (through process water recycling and cascading water uses). The extent of re-use and the specific details as to how water is re-used is industry and process specific. Nevertheless, industrial water use is typically organized according to the quality of water required, as follows:

- Processes requiring high quality water such as steam generation, wash-water in clean environments, foods processing, final product rinsing, product make-up etc;
- Processes requiring moderate water quality such as for cooling, refrigeration, general washing and rinsing, etc; and
- Processes requiring low water quality such as for raw material hydraulic transport, ore washing and milling, dust control, minerals processing etc.

Many industries do not require high quality water for process applications and can therefore use treated wastewater from municipalities and treated effluents from other industries. The wastewater from the upstream user must, however still be adequately treated and prepared for subsequent industrial use.

Industries can be operated as zero effluent discharge (ZED) facilities by adopting the principle of water recycling and re-use. This may require the treatment of industrial effluent to a high standard to allow re-use of water even by sensitive water users, such as for human consumption. **Figure 3** shows an example of potential water re-use applications in a soft drink bottling industry.

[8]The Wealth of Waste: The Economics of Wastewater Use in Agriculture. Winpenny J et al. Food and Agriculture Organisation of the United Nations. Rome. 2010.
[9]Direct Potable Re-use – A Path Forward. Tchobanoglous G. et al. Water Re-use Research. California. 2011.

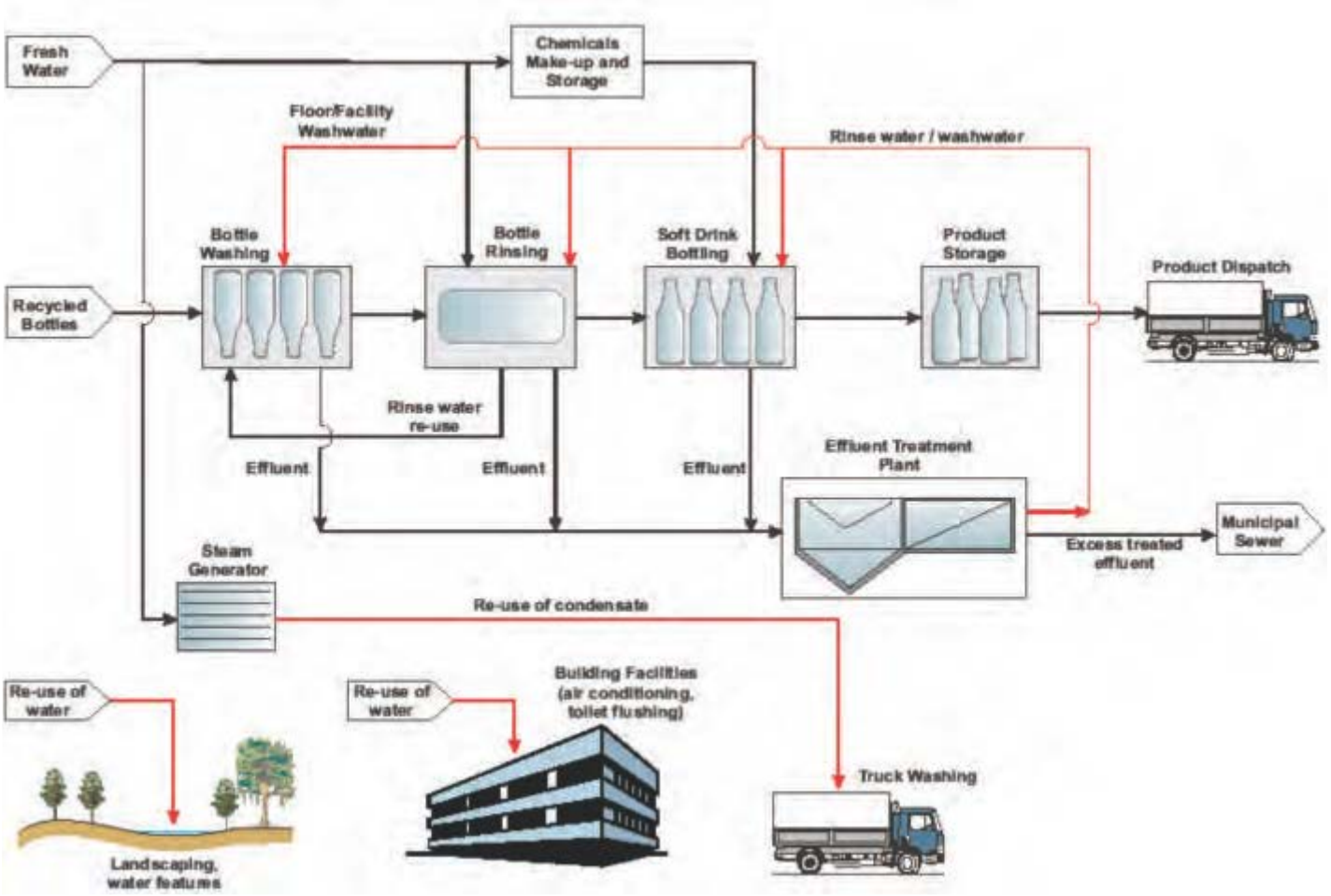


Figure 3: Water re-use applications for a soft drink bottling facility

3.2.5 Mining sector

Mining and minerals processing facilities use large volumes of water and recycling and re-use is widely implemented to reduce costs and to meet environmental requirements. Typical water re-use applications include:

- Cascading use of fresh intake water to different processes which require different water qualities, for example, blowdown from cooling towers can be used to mill the ore
- Capture and use of mining impacted water to replace fresh intake water
- Return and re-use of water from mining waste facilities, such as tailings deposition facilities

Water re-use opportunities in the mining and minerals processing industry are illustrated in **Figure 4.** The issue of acid mine drainage (AMD) is pertinent to the mining sector. AMD can potentially have very negative impacts on the natural aquatic environment and downstream users if left to decant and flow untreated into the fresh water resources. The collection, treatment and re-use of AMD turns the negative impacts into a positive beneficial water use.

3.2.6 Power generation sector

The power generation sector has in the past used and continues to use large quantities of fresh water, requiring in many cases inter-basin transfer of water. As the available fresh water resources become fully utilized, the sector has implemented dry cooling technologies. The need for improved air emission control has, however increased the water requirements. Coal-fired power stations in South Africa are typically operated as zero effluent discharge facilities. The sector is continuously improving the efficient use of water, specifically in the handling and management of ash and waste.

The water requirements and water re-use opportunities in nuclear power generation and renewable energy facilities will have to be understood as South Africa progressively moves to energy diversification.

3.2.7 Environmental requirements

Water supports and sustains natural and man-made aquatic ecosystems by, for example, maintaining minimum flows and appropriate flow regimes in streams, rivers and estuaries, recharging wetlands and maintaining the water levels of man-made water features such as urban lakes and dams.

Re-used water can play an important role in the above, supplementing or even partially substituting for freshwater. However, care must be taken to clearly define receiving water quality objectives and to manage the impact of water re-use on water quality. More advanced treatment may be required to further encourage this form of water re-use and to meet strict receiving water quality requirements.

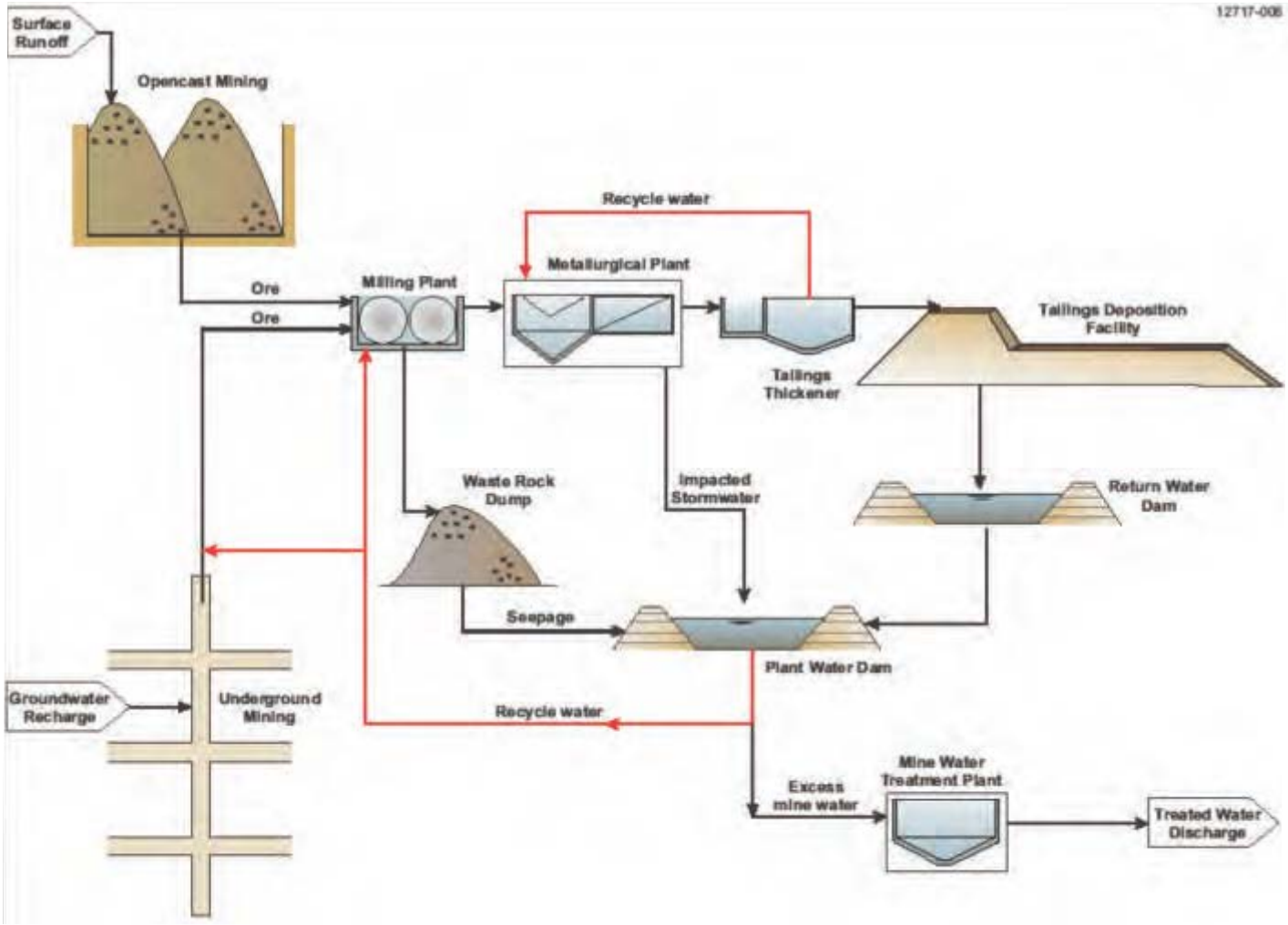


Figure 4: Water re-use applications in the mining and minerals processing industry

4

WATER RE-USE CASE STUDIES

The cost of re-using water relative to other alternatives is one of the most important factors that will determine water re-use decisions. It is therefore important to understand the key factors that will affect costs and how these vary between different applications of re-use and are likely to change over time, relative to other water supply alternatives. It is also important to understand how these costs might be reduced so as to make water re-use more economically attractive. The key determinants of cost are location, water quality, treatment technology and volume (scale).

Because the possible applications of water re-use (and hence the appropriate treatment technologies to be used) are very extensive, it is not feasible to discuss these exhaustively or in any detail here. Instead, five main applications of water re-use are discussed in the form of 'case studies' with the understanding that the approaches and principles emerging from these cases can be applied to other similar water re-use applications. The six 'case studies' are:

- The use of treated municipal wastewater for urban uses
- The use of treated municipal wastewater for industrial use
- Zero discharge mining/industrial facilities
- Rethinking household sanitation and grey water
- The direct re-use of treated municipal wastewater for potable use purposes
- The treatment of acid mine drainage

Appendix A contains a list of selected South African case studies to demonstrate some existing local water re-use projects.

4.1 Using treated municipal wastewater for urban uses

The re-use of treated wastewater for urban applications such as public parks, sports fields, golf courses etc. could replace the use of freshwater. The construction and operation of a separate recycled water reticulation system is relatively expensive and has been an impediment to implementation. Water re-use systems ("purple pipes") have, however been successfully implemented in many countries with appropriate controls and safeguards. The concept of small scavenging wastewater treatment plants, taking wastewater from the sewers and producing a water fit for re-use at the local point of the water requirement may be more cost effective. Municipal bylaws would have to be adapted to encourage but also better regulate such re-use of water.

4.2 The use of treated municipal wastewater for industrial uses

Several successful projects to re-use treated municipal wastewater for industrial processes are in operation in South Africa – refer to Appendix A. These projects typically involve a large wet industry such as a steel mill or pulp/paper mill linked to a source of treated wastewater. The concept is well established and the project drivers are a combination of the factors listed in Section 3.1 of this document. Some innovative implementation models involving private sector financing, operation and maintenance are available. Since an industry is involved, private sector resources can be readily deployed to implement such water re-use projects.

4.3 Zero discharge for mining/industrial facilities

Industries discharging effluents to municipal sewers may require pretreatment to achieve trade effluent standards set in bylaws. Industries discharging effluents back to streams/rivers implement treatment systems to achieve licensed discharge standards. Many wet industries now implement water recycling and re-use projects based on considerations of water availability and cost. Stream/river discharge standards may be strict and the quality of a treated effluent may be adequate for re-use, thus saving the cost of purchasing fresh water. The re-use of a treated industrial effluent may also be a strategic decision to improve the availability of water and diversify on sources of water.

4.4 Rethinking household sanitation and grey water

Conventional waterborne sanitation uses potable standard water to wash away human faeces, in the process combining good quality water with potentially valuable resources (faeces and urine) to create polluted water that needs to be treated. This is not an efficient system in a context where fresh water is scarce and precious and where fertilizer inputs for agriculture productivity are limiting. As resource scarcity and prices change over time, it may make increasing sense to rethink our conventional sanitation solutions and to invest in more environmentally friendly and sustainable alternatives.

Similarly, the implications of current practices of adding phosphates to detergents and soaps used in washing processes, and then combining this water (grey water) with domestic sewage will need to be carefully considered. These practices are likely to need to change in future as fresh water becomes more valuable and the cost of treating polluted water resources becomes higher.

A limited number of countries in the world have implemented urine separation and collection systems, with the aim of nutrient (nitrogen, phosphorous and potassium) recycle to agriculture. Changing household practices at this fundamental level may have significant implications for water use and the availability of wastewater for re-use in the long term. A water re-use strategy that is forward thinking over ten to twenty years needs to take these possible changes into account. The economic tipping point for the implementation of alternative household sanitation approaches will dictate the speed of change.

4.5 Direct re-use of treated municipal wastewater for potable purposes

The direct re-use of treated municipal wastewater for potable purposes is practised at a limited number of locations in the world. The knowledge of municipal wastewater composition and sophisticated treatment technologies has advanced to the point where this can be considered as an option in the spectrum of water supply alternatives. Specific opportunities exist in the coastal communities and cities where treated municipal wastewaters are discharged to the ocean, effectively losing an opportunity for water re-use.

The implementation of such direct re-use projects will, however, have to overcome perceptions and risks related to public acceptance, trust in scientific knowledge and engineered systems, trust in water supply authorities, social justice and fairness.

Direct re-use of treated municipal wastewater for potable purposes would only be practical where sophisticated technology, competent operational and management systems and safeguards are in place to protect the public health.

4.6 Treatment of acid mine drainage

Acid mine decant or drainage is a potentially important source of water for re-use. This water must be treated to limit current and future environmental damage to water resources, and can be treated for re-use for industrial and even potable water use purposes.
Several AMD treatment and re-use projects have now been implemented in South Africa demonstrating the technical feasibility, financial viability and stakeholder acceptance of such projects. Challenges remain to address the issues of appropriate and long term (post mine closure) operation and maintenance of such AMD re-use schemes.
AMD treatment and re-use projects could utilize the large storage available in mining workings, do not have to contend with evaporation loss of water and can deliver reclaimed water in proximity to several large urban areas, such as the Witwatersrand and Mpumalanga Highveld. .

5

NATIONAL STRATEGY FOR WATER RE-USE

5.1 Promoting sound decision making

The implementation of water re-use can take place at different scales or levels: at a very local level involving a single facility such as a building or a factory, for a group or cluster of facilities, at a treatment facility level (for example, such as a municipal treatment works) or at a river system level (natural drainage areas/catchments). Decision-making will vary across these applications and could involve individual or groups of households or businesses, municipalities and national government (including entities owned by government).

The intent of the water re-use strategy is to encourage wise decisions relating to water re-use for all of these different decision makers. There are three important factors that can enable and support good decision making:

- A sound and clear policy and legislative framework, that is, decision-makers and water users know what their rights and obligations are, and what they can and cannot do.
- The benefits, risks and costs are clearly understood, and prices and costs accurately reflect the relative benefits and costs between alternatives so that incentives are not distorted.
- Decision makers have access to relevant information and support to make informed decisions, with the necessary support and backup to implement water re-use projects.

Each of these aspects are addressed in further detail below.

5.2 Creating a clear policy and legislative environment

Water re-use projects typically involve a range of activities that are subject to regulatory authorization and control. These controls exist in a range of legislation that includes, but is not limited to the National Water Act, (Act 36 of 1998), the Mineral and Petroleum Resources Development Act, (Act 28 of 2002), the National Environmental Management Act, (Act 107 of 1998), the National Environmental Management: Waste Act, (Act 59 of 2008), the Water Services Act, (Act 108 of 1997), the National Environmental Management: Integrated Coastal Management Act, (Act 24 of 2008), and municipal by-laws.

The fact that these controls exist in so many different acts, and that regulatory approaches may differ between the acts, makes it difficult to implement water re-use projects confidently, speedily and cost-effectively. This makes water re-use projects less favourable compared to other alternatives, even where it is practical and cost-effective to re-use wastewater.

The Department of Water Affairs will address this issue by:

- Developing clear and practical guidelines for typical water re-use projects on what regulatory approvals are needed, the status of reclaimed water in terms of right to use and how these can be obtained cost and time effectively (see 'guidelines' below)
- Working with other national departments to align legislation, reduce the regulatory burden wherever practical, and unblock regulatory obstacles to water re-use
- Act as the lead regulatory authority to assist in working with other Departments in getting approval for justifiable water re-use projects
- Working with municipalities to ensure that municipal by-laws support the appropriate re-use of water
- Ensuring the water quality standards implemented are appropriate in a context where water re-use is a strategic imperative (see 'reviewing water quality standards' below)

- Use the water licensing process as a key tool to promote water use efficiency
- Implement the waste discharge charge system

The Department will also review water related laws and regulations to assess the need for revision driven by water re-use. Legislation may then be revised to accommodate the need to facilitate, streamline, encourage and control water re-use projects.

5.2.1 Reviewing water quality standards

Water quality standards for discharges into the water resource and water quality standards and regulations for different types of water use (for example, minimum standards for potable water use, irrigation use for food and non-food crops) play a large role in influencing water re-use decisions. It is important that these standards are not so onerous that they make treatment for re-use prohibitively expensive and not so lax that they compromise public safety and the environment.

This is a complex area of regulation and considerable attention has already been paid to this in South Africa. The following standards exist:

- South African Water Quality Guidelines for a number of different water user sectors (DWAF, 1996)
- Drinking water quality standards (SANS 241, 2005, Edition 6), and the
- General and Special Standards pertaining to the discharge of treated wastewater to the water resource.

These standards and guidelines were not specifically developed to address the issues associated with water re-use. Worldwide research into water re-use is producing new information, which needs to be considered in guiding and regulating water re-use projects. The Department will review and/or develop standards and guidelines for water re-use.

Water re-use projects may be implemented for a large spectrum of potential water users. The different categories / types of water re-use will require quantitative standards to define and manage the fitness for use. The standards must be developed to address the following aspects:

- Water quality variables of concern in a specific water re-use application
- Quantification of risk and acceptable risk levels, and
- Monitoring requirements in terms of water quality variables, frequency and location of sampling / analysis.

5.3 Clear incentives

Water re-use projects are much more likely to be implemented where it is more cost-effective compared to other water supply alternatives. Households and business have limited budgets and will generally choose least cost options to meet their water use needs. Similarly, municipalities are resource constrained and typically opt for least cost choices related to securing water supplies for their residents in order to limit water price and municipal rates increases.

Sound water re-use outcomes will arise where the relative costs and benefits of alternatives are not distorted. Where fresh water supplies are heavily subsidized, water users are much less likely to choose water re-use options even if these options are cost-competitive with the cost of securing additional fresh water supplies. Conversely, subsidizing the re-use of water is unlikely to lead to least-cost outcomes and the efficient allocation of resources.

The Department will take the importance of price signals and incentives in water re-use decisions into account when reviewing the raw water pricing strategy.

5.4 Information to support sound decision making and implementation

The Department recognizes the important role that good information plays in supporting sound decisions. There are three aspects of information to consider: educating users with respect to the benefits and acceptance of water re-use; providing people who are considering water re-use with clear guidelines on how to implement water re-use projects, and sound methodology in the evaluation of options to balance water requirements and supply.

5.4.1 Methodologies for evaluating water resource development options

Water resource reconciliation studies undertaken for specific catchments and water systems in South Africa routinely consider conventional water supply augmentation options alongside water re-use, desalination and water conservation and demand management options.

The Department will continue to develop and refine the methodologies used to assess options to ensure that options are evaluated on a comparable basis and that the methodologies employed support sound decision making.

5.4.2 Guidelines for implementing water re-use projects

The Department will develop guidelines for the implementation of water re-use projects. These guidelines will support sound decision making and implementation. The guidelines will address the management and control, project implementation, choice of technology, operations and maintenance, project financing, development and implementation of tariffs and public and stakeholder education, engagement and consultation. Separate guidelines will be developed for different types of water re-use projects.

5.4.2.1 Technology selection

The selection and implementation of the appropriate treatment technology are key to the successful implementation of water re-use projects. It is strategically important to achieve this objective by:

- Selecting capable agencies/organisations with knowledgeable and competent staff to implement and operate re-use projects;
- Planning and executing the procurement of technology with the appropriate emphasis on functionality and proven performance;
- Ensuring that local knowledge of and support for the technology are available; and
- Providing technology guidance and training to re-use project implementing agencies/organisations.

5.4.3 Public education and awareness

The concept and implementation of water re-use will require a focused and sustained public education program to develop and entrench awareness of the different facets of water use and specifically water re-use.

Multiple awareness creation and information campaigns related to a spectrum of water related matters are launched by the Department, public institutions and private companies each year. It is important to develop and incorporate communication material related to water re-use into these campaigns.

Public perceptions and opinions vary on the topic of water re-use, specifically as it relates to indirect or direct water re-use. A structured communication strategy must be developed and implemented based on:

- An understanding of the diversity of perceptions and opinions
- Appropriate material to inform the public and stakeholders
- Active communication and debate on the topic
- Targeted media coverage

The overall objective of public awareness creation and information dissemination programs is to enhance the understanding and promote informed decision making related to water re-use. The current public perceptions and awareness of the poor operation, maintenance and performance of municipal wastewater treatment plants pose a specific challenge. It will be difficult to gather support for municipal water re-use within the current situation. The national efforts to address the poor performance of municipal wastewater and effluent treatment plants may have to show results on a consistent basis, before placing municipal water re-use onto the national water agenda.

5.5 Technology innovation and development

A range of water re-use projects have been implemented in South Africa (see Appendix A). South Africa has the potential to be a leading innovator in water re-use technology, particularly in the area of the treatment of acid mine drainage.

The Department will encourage the Water Research Commission (WRC) to make water re-use technology development a key focus area, and encourage the development of centers of excellence at selected universities.

5.6 Capacity to implement

5.6.1 Competent implementing agencies

Water re-use projects have many sophisticated technical, engineering, financial, operational and maintenance aspects. A key consideration to any such project is the fact that the water typically has to be treated to improve/upgrade its quality, before it is fit for re-use by a downstream user. The downstream user must be guaranteed an appropriate quality of water to protect designated use of the water. Re-use projects therefore require a high level of confidence in the implementation and operating agencies.

A public sector agency, such as a municipality or water board must have a minimum threshold of capacity and competency, (in terms of technical expertise, planning ability, project management capability, financial strength and rating), be a trusted water services deliverer and be accepted by the community and stakeholders as a reliable organization, before it can be considered as capable of implementing a water re-use project.

An agency/organisation must be able to demonstrate the capability to implement water re-use projects. It is therefore likely that the agencies and organisations with an acceptable capability and capacity profile to implement water re-use projects would be limited to metropolitan municipalities, water boards, some larger local municipalities, private companies specialised in the water sector and public private partnerships.

Private sector management, engineering and financing capacity related to water re-use, as demonstrated by several successful water re-use projects in mining and industry, is well established in South Africa. International interest in local water re-use projects has been expressed. The substantial private sector capacity must be leveraged in the implementation of water re-use projects.

The Department will investigate, together with established professional bodies in the water sector; the merits of establishing an industry-agreed evaluation/accreditation system for agencies/organisations implementing water re-use projects.

5.6.2 Developing the necessary skills for operating and maintaining water re-use systems

Water re-use projects will typically incorporate more sophisticated treatment technology and systems compared to conventional surface water and groundwater treatment. Such projects will fail unless trained, knowledgeable and motivated operations and maintenance staff is available. It is strategically important to implement the following actions:

- Prepare an assessment of the current and future skilled and trained people needed to operate water reclamation, water recycling and water re-use projects
- Encourage water services authorities and water services providers to consider and plan for the staffing and training needs to support water re-use projects, and
- Alert training and educational institutions in the water sector of growing needs for trained and skilled operations and maintenance staff.

The planning and implementation of water re-use projects must also include a comprehensive assessment of operations and maintenance aspects, including staffing, resources and system requirements.

5.7 Financing water re-use projects

Water re-use projects can be financed through the Municipal Infrastructure Grant, loans from development and commercial banks, project financing linked to public-private partnerships and through bonds issued by agencies such as the Trans Caledon Transfer Authority (TCTA). The waste discharge charges can also provide a source of funding for water re-use projects. This may specifically apply to indirect water re-use projects, where an upstream wastewater discharge containing residual waste is re-used by a downstream water user. The downstream user may have to implement relatively sophisticated and expensive water treatment technology and systems to produce water fit for use. The income generated by the waste discharge charge system may be applied to offset the incremental treatment cost associated with a re-use project.

Financing considerations are similar to those for other water resource development projects, except that the risk profile of the project may be different.

Tariffs can be applied specifically for different water re-use applications. Tariff setting may be subject to the National Water Act (Act No. 36 of 1998), the Water Services Act (Act No 108 of 1997), the Municipal Systems Act (Act No. 32 of 2000) and the Public and Municipal Financial Management Acts (Act No. 1 of 1999), depending on the specific application.

5.8 Enforcement

The performance of existing wastewater treatment plants in terms of meeting discharge standards and reliability is critical to the successful application of water re-use in South Africa. These facilities discharge water that impacts on the safety, economy and fitness for use by downstream users. Strict enforcement of discharge standards, and addressing the management and performance failures of municipal wastewater treatment plans is therefore critical to the future of indirect water re-use.

5.9 Recognition of success

South Africa has implemented a number of successful water reclamation and re-use projects in diverse sectors of the economy. It is also necessary to recognize water re-use as an important aspect of the efficient and responsible provision of water services. Consideration may in future be given to a "purple drop" recognition of safe and successful water re-use projects and operations, similar to the blue drop and green drop awards.

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APPENDIX A
Selected Water Re-use Projects in South Africa

Source of Reclaimed Water			Reclaimed Water User		Type or Re-use	
Water Services Authority	**Facility**	**Level of treatment**	**Institution/**	**Category of use**	**Planned / unplanned**	**Direct/Indirect**
City of Cape Town (Metropolitan Municipality)	Potsdam WWTP	Secondary, tertiary	Organization	Industrial, process water	Planned	Direct
Saldanha Bay Local Municipality	Urban Stormwater	Storage, infiltration	Chevron Refinery	Recharge of aquifer	Planned	Direct
City of Johannesburg (Metropolitan Municipality)	-	Secondary, disinfection	Kelvin Power Station	Industrial, cooling water	Planned	Direct
Rustenburg Local Municipality	Rustenburg WWTP	Secondary, disinfection	Platinum Mines	Metallurgical process and mining process water	Planned	Direct
City of Tshwane Metropolitan Municipality	Rooiwal WWT	Secondary, disinfection	Rooiwal Power station	Industrial, cooling water	Planned	Direct
eThekwini Municipality (Metropolitan)	Southern WWTP	Secondary, tertiary	Mondi Paper Company	Industrial, cooling water	Planned	Direct
Metsimaholo Local Municipality	Sasol 1 WWTP	Secondary trickling filtration	Sasol, Sasolburg	Industrial Process water	Planned	Direct
Emalahleni Local Municipality	Emalahleni Water Reclamation Plant	Advanced, disinfection	Emalahleni Municipality	Drinking and municipal water	Planned	Direct
Steve Tshwete Local Municipality	Optimum Water Reclamation Plant	Advanced, disinfection	Steve Tshwete Municipality	Drinking and municipal water	Planned	Direct
Steve Tshwete Local Municipality	Boskrans Wastewater Treatment Plant	Secondary, disinfection	Kanhym Feed Lots	Agro industry use	Planned	Direct
Lephalale Local Municipality Polokwane Local Municipality	Lethabo Water reclamation Plant	Advanced membrane treatment	Lethabo Power Station	Industrial, cooling water	Planned	Direct
Polokwane Local Municipality	Pietersburg Wastewater Treatment Plant	Secondary, disinfection	Platinum Mines	Mining and metallurgical process water	Planned	Direct
City of Johannesburg (Metropolitan Municipality)	Southern Wastewater Treatment Works	Secondary, disinfection	Water users along Middle Vaal River	Full Spectrum	Planned	Indirect
City of Johannesburg (Metropolitan Municipality)	Northern Wastewater Treatment Works	Secondary, disinfection	Water users along Crocodile West River	Full spectrum	Planned	Indirect
City of Tshwane Metropolitan Municipality	Zeekoegat Wastewater Treatment Works	Tertiary, disinfection	City of Tshwane via Wallmansthal Plant	Potable	Planned	Indirect
Msunduzi Local Municipality	Darvill Wastewater Plant	Secondary, disinfection	Umgeni Water	Potable from Inanda Dam	Planned	Indirect
Emalahleni Local Municipality	Wastewater Treatment Works	Secondary, disinfection	Loskop Dam water users	Mainly irrigation, but full spectrum	Planned	Indirect

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