Water Resource Planning
Systems Series

SUB-SERIES NO. WQP 1.7.6

Resource Directed Management of Water Quality

Introduction

August 2006

water & forestry

Department:
Water Affairs & Forestry
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

Water Resource Planning Systems Series

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Resource Directed Management of Water Quality

Introduction

August 2006

Edition 2

Published by

Department of Water Affairs and Forestry
Private Bag X313
PRETORIA, 0001
Republic of South Africa

Tel: (012) 336 7500/ +27 12 336 7500
Fax: (012) 336 6731/ +27 12 336 6731

ISBN No: 0-621-36786-9

This report should be cited as:

Department of Water Affairs and Forestry (DWAF), 2006. Resource Directed Management of Water Quality: *Introduction*. Edition 2. Water Resource Planning Systems Series, Sub-Series No. WQP 1.7.6. ISBN: 0-621-36786-9. Pretoria, South Africa.

Co-ordinated by:

CSIR, Natural Resources and the Environment (NRE)
PO Box 395
Pretoria
0001

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Bold type indicates this report.

*These reports are internal project management documents that are not available for publication.

** These reports are earlier versions that have been improved upon in the second edition and thus are not available for publication.

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APPROVAL

TITLE: Resource Directed Management of Water Quality: Introduction

DATE: August 2006

AUTHORS: Hanlie Hattingh and Kevin Murray

REVIEWERS: Dirk Roux and Peter Ashton

EDITORS: Hanlie Hattingh, Retha Stassen and Jurgo van Wyk

LEAD CONSULTANT: CSIR: Natural Resources and the Environment (NRE)

SUB-SERIES NO.: WQP 1.7.6

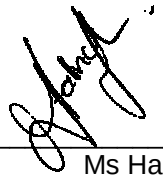
ISBN NO.: 0-621-36786-9

FILE NO.: 16/3/4/96

FORMAT: MSWord and PDF

WEB ADDRESS: www.dwaf.gov.za

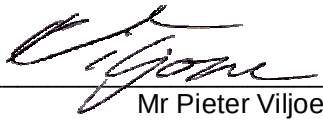
Approved for CSIR, NRE:



Ms Hanlie Hattingh
CSIR Project Leader and Manager

Dr Dirk Roux
CSIR Project Co-Leader

Approved for the Department of Water Affairs and Forestry by:



Mr Pieter Viljoen
Deputy Director: Water Resource Planning Systems: Water Quality Planning

Mr Chris Moseki
Director: Water Resource Planning Systems

ACKNOWLEDGEMENTS

The following individuals are thanked for their contributions to the document:

Project Management Committee

Pieter Viljoen	Department of Water Affairs & Forestry (DWAF)	Project Manager
Jurgo van Wyk	Department of Water Affairs & Forestry	Assistant Project Manager
Retha Stassen	Department of Water Affairs & Forestry	Project Co-ordinator
Hanlie Hattingh	CSIR NRE	Consultant Project Leader and Manager
Dirk Roux	CSIR NRE	Consultant Project Co-Leader

Project Team

Hanlie Hattingh	CSIR: NRE	Consultant Project Leader and Manager
Kevin Murray	Insight Modelling Services	Policy Formulation

Specialist Review

Dirk Roux	CSIR: NRE	Aquatic ecosystems
Peter Ashton	CSIR: NRE	Policy

Members of Project Steering Committees

Althea van der Merwe	DWAF: Mpumalanga Regional Office
Anet Muir	DWAF: Water Abstraction and Instream Use (Environment & Recreation)
Anthony Turton	Gibb-Sera Chair in IWRM (CSIR)
Ashwin Seetal	DWAF: Water Allocation
Barbara Schreiner	DWAF: Policy and Regulation Branch
Barbara Weston	DWAF: Resource Directed Measures
Bettie Conradie	DWAF: Northern Cape Regional Office
Bill Rowlston	DWAF: Policy and Strategy Coordination
Carin Bosman	DWAF: Resource Protection and Waste
Chris Moseki	DWAF: Water Resource Planning Systems
Cornelius Ruiters	DWAF: Water Use
Danie Smit	Department of Environmental Affairs & Tourism
Dawie Maree	DWAF: Gauteng Regional Office
Derek Weston	DWAF: Water Management Institutional Governance
Dirk Roux	CSIR: NRE
Eddie van Wyk	DWAF: Hydrological Information
Elize Swart (NC Khoza)	Department of Minerals & Energy
Ernita van Wyk	CSIR: NRE
Eustathia Bofilatos	DWAF: Water Management Institutional Governance
Fanie Botha	DWAF: Water Resource Planning Systems
Frank Wimberley	Golder Associates: Source Directed Measures Consultant
Frans Stoffberg	DWAF: National Water Resources Planning
Gareth McConkey	DWAF: Western Cape Regional Office
Guy Pegram	Pegasus
Gys Hoon	DWAF: Free State Regional Office
Hanlie Hattingh	CSIR: NRE
Harrison Pienaar	DWAF: Resource Directed Measures
Henry Abbott	DWAF: Resource Protection and Waste (Waste Discharge & Disposal)
Herman Keuris	DWAF: Information Programmes
Hugh Dixon-Paver	DWAF: KwaZulu Natal Regional Office
Jaco Nel	DWAF: Hydrological Information
Jacob Matlala	DWAF: Limpopo Regional Office

Jean Msiza	DWAF: Stakeholder Empowerment
Jurgo van Wyk	DWAF: Water Resource Planning Systems
Kevin Murray	Insight Modelling Services
Liesl Hill	CSIR: NRE
Linda Godfrey	CSIR: NRE
Loraine Fick	DWAF: Water Abstraction and Instream Use
M Phaloane	Nunganie Development Consultant
Manda Hinsch	DWAF: Resource Protection and Waste (Waste Discharge & Disposal)
Maria Matooane	DWAF: Free State Regional Office
Marius Claassen	CSIR: NRE
Marius Keet	DWAF: Gauteng Regional Office
Marlese Nel	DWAF: Information Programmes
Martin van Veelen	BKS
Mike Warren	DWAF: Water Abstraction and Instream Use
Minolen Reddy	DWAF: Mpumalanga Regional Office
Mzuvukile Tonjeni	DWAF: Eastern Cape Regional Office
Nancy Gcwensa	Department of Health
Nicky Naidoo	Nemai Consulting
Niel van Wyk	DWAF: National Water Resources Planning
Obet Baloyi	DWAF: Water Abstraction and Instream Use
Peter van Niekerk	DWAF: Integrated Water Resources Planning
Petrus Venter	DWAF: North West Regional Office
Piet Pretorius	DWAF: Water Abstraction and Instream Use
Pieter Viljoen	DWAF: Water Resource Planning Systems
Priya Moodley	DWAF: Water Resource Planning Systems
Retha Stassen	DWAF Project Co-ordinator
Riana Munnik	DWAF: Gauteng Regional Office
Sakkie van der Westhuizen	DWAF: Resource Protection and Waste (Waste Discharge & Disposal)
Sebastian Jooste	DWAF: Resource Quality Services
Simon Moganetsi	DWAF: Water Abstraction and Instream Use
Solly Maluleke	Department of Land Affairs
Sonia Veltman	DWAF: Water Resource Planning Systems
Steve Mitchell	Water Research Commission
Suzan Oelofse	DWAF: Water Resource Planning Systems
Tinyiko Malungani	CSIR: NRE
Toni Belcher	DWAF: Western Cape Regional Office
Tlhagala R Mgogsheng	DWAF: Limpopo Regional Office

FOREWORD

The Constitution of the Republic of South Africa (1996) ushered in an era aiming at the promotion of sustainability, where social, ecological and developmental issues are considered to be equally important. The South African National Water Policy (1997) and the National Water Act (1998) were promulgated with the specific purpose to ensure that the nations' water resources are protected, used, developed, conserved, managed and controlled in an equitable, efficient and sustainable manner.

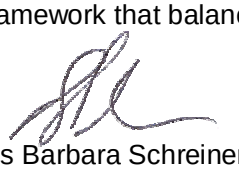
To support these objectives, a number of changes were required in the national approaches to water (resource) management. One of the most substantial changes was stipulating the Reserve, the highest priority water use in the Act, and the only water allocation that is protected in law. The Reserve comprises two components: the Basic Human Needs Reserve and the Ecological Reserve. The Basic Human Needs Reserve refers to the quantity and quality of water that is required to meet basic human needs, typically 25 **l** per person per day, within 200 m of the source. While, the Ecological Reserve refers to that quantity and quality of water that is needed to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.

Various methods used to determine the quantity of water available for use have been developed and are generally available. The challenge was to develop appropriate methods to determine the levels of stress in water resources and then to identify, from a water quality perspective, what proportion (if any) of the water resource could still be allocated for use by the other recognised water users, *i.e.* domestic, industrial, agriculture and recreation. These need to be implemented in a carefully integrated and structured manner to ensure efficiency, sustainability and equity. This challenge is complex due to the nature of water resource management, the need to integrate water quantity and quality, and the need to make decisions in a multi-criteria environment.

The series of documents and instruments dealing with RDMWQ have been developed to assist in making water resource management water quality-friendly. In other words, to operasionalise the management of water quality from a resource perspective. This is achieved through the interpretation of policy principles from a resource directed water quality perspective, and determining the allocatable water quality component of a specific water resource. The series of RDMWQ documents and instruments form part of the iterative decision-making framework for making the policy operational through water quality resource allocation.

The RDMWQ documents and instruments consist of a RDMWQ Policy and Strategy (including summaries), a RDMWQ institutional arrangements guideline, a suite of management instruments and additional supporting documents. The management instruments facilitate the implementation of the RDMWQ policy, with a catchment visioning guideline, procedures to determine resource water quality objectives and the allocatable resource, a guideline for determining stress levels, a guideline for converting objectives to end-of-pipe discharge standards, and a monitoring and auditing guideline. Much of the above is consolidated into a dedicated decision support system.

It is intended that these RDMWQ documents and instruments will promote integration of water quality and quantity aspects within Water Resource Management. These tools should also support the principles of equity, efficiency and sustainability, while providing a robust, but predictable framework that balances protection with water use and development on a sustainable basis.



Ms Barbara Schreiner

Deputy Director-General: Policy and Regulation
Department of Water Affairs and Forestry

Date: 01/09/2006

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DWAF	Department of Water Affairs & Forestry	RWQOs	Resource Water Quality Objectives
NWA (36:1998)	National Water Act	SDC	Source Directed Controls
RDMs	Resource Directed Measures	WQM	Water Quality Management
RDMWQ	Resource Directed Management of Water Quality		

I N T R O D U C T I O N

1. Purpose

The Water Resource Planning System Series (Sub-series No. WQP 1) provides policy, strategy and management instruments to facilitate the management of water quality from a resource perspective.

This introduction provides (a) the background to the particular sub-series, (b) an overview of the general context in which resource directed management of water quality is practiced, and (c) an overview of the content of the sub-series itself.

2. Background

The promulgation of the National Water Act, 1998 (Act No. 36 of 1998), various other acts, policies and White Papers (e.g. White Paper on a National Water Policy for South Africa, 1997) gave a new direction to water resources management and, more specifically, the management of water quality in South Africa.

The primary purpose of the National Water Act (NWA (36: 1998)) is to ensure that the nations' water resources are protected, used, developed, conserved, managed and controlled in an equitable, efficient and sustainable manner. This necessitates an integrated source-, resource- and remediation-focused approach to water quality management (WQM).

Limited policy guidance was available on resource related management of water quality. Furthermore, it was unclear how resource management should guide source management relating to water quality. Assessments to date were generally done on an *ad hoc* basis with little uniformity.

A number of mechanisms to facilitate management of water resources were introduced with the promulgation of the NWA (36: 1998), such as resource directed measures (RDMs). The current priority of the Department is to implement both source and resource directed management approaches in an integrated and structured manner. Sub-series WQP 1 focuses specifically on the water quality aspects of the water resource.

2.1 The National Water Act

In terms of the NWA (36:1998), the following are prominent management functions of the Department:

- Protection of the nation's water resources by ensuring sufficient water quantity of appropriate water quality to satisfy the basic human needs and ecological Reserve, as well as the needs of the other recognised water users (*sustainability*);
- Management and control of the nation's water resources to ensure the sustainable utilisation of water resources in the long term (*efficiency)*; and
- Equitable allocation of available water to different water users (*equity*).

The fundamental principle guiding the NWA (36:1998) of South Africa is that water is a national resource, owned by the people of South Africa. National Government has overall responsibility for, and authority over, the management thereof. This includes utilisation of all aspects of the resource.

3. Contextual Overview

Some of the text used in this introductory chapter has been sourced from the following project documents; these documents are also available as Appendices to the Resource Directed Management of Water Quality (RDMWQ) sub-series:

- Department of Water Affairs and Forestry, 2006. Water Resource Planning Systems Series, Sub-Series No. WQP 1.7.4, Resource Directed Management of Water Quality: Project Document: Philosophy of Sustainable Development. Edition 1. Pretoria. (Appendix A)
- Department of Water Affairs and Forestry, 2006. Water Resource Planning Systems, Sub-Series No. WQP 1.6.1, Resource Directed Management of Water Quality: Project Document: Conceptual Review for water use licence applications from a RDWQM perspective. Edition 1. Pretoria. (Appendix B)
- Department of Water Affairs and Forestry, 2006. Water Resource Planning Systems, Sub-Series No. WQP 1.7.5, Resource Directed Management of Water Quality: Project Document: Guidelines for Setting Licence Conditions for Resource Directed Management of Water Quality. Edition 2. Pretoria. (Appendix C)

3.1 Sustainable development

3.1.1 History

The 1960's witnessed a widespread recognition of the impact of expanding global environmental crises due to industrialisation and this fuelled a growing realisation that, if we continued on the current development trajectory, we would exceed most of the earth's ecological limits. At the 1972 Stockholm UN Conference on Human Environment, it was recognised that the environment-development conflict would have to be resolved in a mutually beneficial manner. The idea of sustainable development evolved out of the debates around environment and development as a means to promote development whilst still ensuring environmental protection.

A widely accepted definition of sustainable development has been provided by the World Commission on Environment and Development (1987), which describes it as "development that meets the need of current generations without compromising the ability of future generations to meet their own needs and aspirations".

The expression and concept of sustainable development originated from a realisation that the earth's natural resource base can pose ecological limits to development. Therefore, it is important to realise that the concept of sustainable development originates from the ecological school of thought. Similarly, it must be recognised that the term sustainable development is often used outside of the context in which it originated, and expressions such as economic and social sustainability are also used.

The Constitution of the Republic of South Africa (Act No. 108 of 1996) clearly states that reasonable legislative and other measures should be used to "secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development" (Section 24 (b) (iii)).

Accordingly, for the purposes of this sub-series, the context in which the term sustainable development is used is an ecological one; thus, we are referring to development that is ecologically sustainable.

3.1.2 Current Understanding

Sustainable development requires ongoing interaction between the ecological resource, the economic system and the social system (WCED, 1987, Mebratu, 1998). The economic system exists within and because of the social system, while the social system and human existence is only possible within the ecosphere (the ecological system). This conceptual "nesting" of systems represents the reality of how systems function (Figure 1).

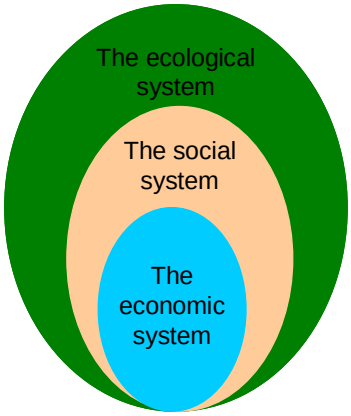

Figure 1: The cosmic interdependence model (adapted from Mebratu, 1998)

Modern society has tended to disaggregate these three systems in order to simplify the inherent complexity of these systems and also to attempt to understand and manage the world around us. Typically, this nested system has been separated into three separate components (namely three spheres).

However, most previous attempts to manage one system in isolation of the others have led to social injustice, unfair trade and economic imbalances, environmental degradation, and ineffective governance. The concept of sustainable development embodies integrating these three systems, whereby there is a central area of overlap encircled by good governance (Figure 2).

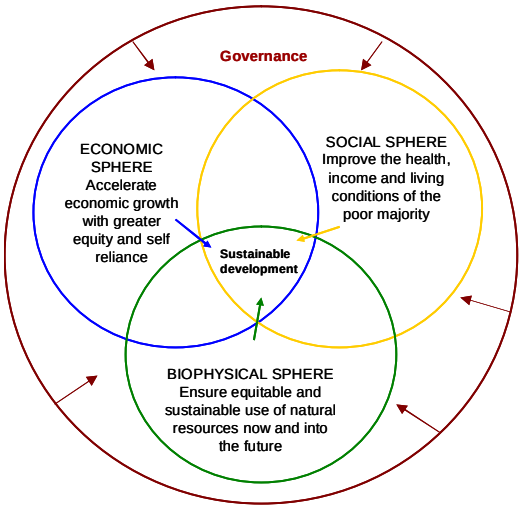

Figure 2: The trifocal approach of sustainability (adapted from MMSD, 2002)

It is perhaps most useful to think about sustainability as the direction we need to move in, in order to achieve an acceptable balance between the three spheres. Sustainability is about the actions we take and the decisions we make to realise sustainable development. Sustainable development can only be achieved through recognising that all three spheres interact and must be addressed together in a holistic manner.

This process is ordered, sustained and grown by good governance. It is both a process of development and a series of stages along a development trajectory (Figure 2).

3.1.3 Approaches

Human-centred approach

In the early days of industrialisation, a *human-centred approach* dominated much of the world's thinking in the early half of the 20th century, with humans being seen as the most important species on earth. According to this attitude to natural resources:

- Humans are apart from, and in charge of, the rest of nature;
- The earth has an unlimited supply of resources to which we can gain access through science and technology;
- All economic growth is good and the potential for economic growth is unlimited;
- A healthy environment depends on a healthy economy; and
- Human success is dependent on how well we can control nature to our benefit.

This highly consumptive approach led to the global crises which, in turn, prompted the concept of sustainable development.

Ecocentric approach

In adopting the principles of sustainable development, it was recognized that a new approach was needed to guide human attitudes towards natural resources. This new approach, described as an *ecocentric view*, saw humans as working with and within nature. According to this approach:

- Nature exists for all of Earth's species and humans are not apart from or in charge of the rest of nature;
- Earth's resources are limited, should not be wasted, and should be used in a sustainable way for us and all species;
- Some forms of economic growth are beneficial but some are harmful;
- A healthy economy depends on a healthy environment; and
- Our success depends on learning to co-operate with one another and the rest of nature (Tyler Miller, 1994).

Stewardship approach

In South Africa, natural resource management is underpinned by the recognition that humans have a duty of care for maintaining natural resources in a healthy state. This *stewardship approach* is eloquently captured in South African law through the Constitution of the Republic of South Africa (Act No. 108 of 1996), which sets out the right of every South African to have an environment that is "not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations" (Republic of South Africa, 1996, section 24 (a)&(b)). This approach is also evident in the Department's appointment as the public trustee of the nation's water resources.

Multi-level considerations

In discussions about sustainable development and natural resource management, it is important to understand that there are different levels at which sustainability and natural resource management must be considered.

At a national level a strategy is necessary to ensure we have healthy, well-functioning natural resources that are able to meet both human and ecological needs. However, at lower levels it is sometimes necessary to find a balance between the various needs of water users and the needs of ecological systems. In this context, balancing may require a "trade-off". Costs and benefits include both positive and negative impacts on the biophysical environment as well as the costs to society and to the national economy, now and in the future.

3.1.4 Water resources

Sustainable development in respect of water resource management seeks to ensure that future generations will still be able to meet their own basic water needs, while promoting socio-economic development and improved quality of life for all in the current generation. This can only be done in a manner that uses water resources in general within the ability of the ecosystem to satisfy such needs, both now and in the future (DWAF, 2006a).

Society benefits immeasurably from water resources. In fact, survival of human society depends entirely on water, resources associated with water, and the goods and services they provide. These goods and services include for example: water supply; waste disposal; processing and dilution; natural products (e.g. fish, reeds, medicinal plants); biodiversity conservation; flood control; and places for rituals or spiritual needs.

Inevitably, there will be conflicting demands for water at the water management area and local levels. These include the conflicting needs for water for economic development, water to meet basic human needs and water to maintain ecosystems. The water resource manager must therefore at a local level manage the development of different types of capital. Water resource managers, however, need to understand how the management of their particular area contributes to the achievement of the national vision in the long-term.

The National Water Resource Strategy aims to find a balance between protection of water resources and social and economic development. The strategy states that "it is not possible for all resources throughout the country to be given a high level of protection without prejudicing social and economic development. Equally, it is not desirable for all resources to be classified at a uniformly low level so as to permit maximum use" (DWAF, 2004a). The net result must therefore ensure that a balance between the social, economic and ecological imperatives of the country is met without unsustainable compromises.

At national level, effective water resource management in South Africa requires an accepted national vision for our water resources. This vision seeks to ensure that water resources are sustained into the future to meet future needs while still improving the quality of life of present generations – a sustainability ethos is thus encouraged.

3.2 Managing water resources

To manage water resources, the National Water Policy (DWAF, 1997) and the NWA (36:1998) present two sets of complementary strategies that lawfully bind all water users. These are: Resource Directed Measures (RDMs) and Source Directed Controls (SDC) (DWAF, 2006b).

3.2.1 Resource Directed Measures

RDMs focus on the quality of the water resource itself, regarding it as an ecosystem rather than a commodity. RDMs comprise the following components:

- ***Classification system***: The purpose is to provide a set of nationally consistent rules to guide decision making about water resources - what will be allowed to happen in our water resources and what will not be allowed to happen. The management class is a combination of the ecological requirements for the resource and the requirements of other water users within the catchment.

  As a precursor to the classification process, ***catchment visioning*** needs to be done. This is a process of articulating a collective statement of future aspiration of society's relationship with the water resource – of the benefits derived from aquatic ecosystem goods and services and the costs associated with their use.

- ***The Reserve*****:** This is the quantity and quality of water required to satisfy the basic human needs, and to protect aquatic ecosystems, in order to secure ecologically sustainable

development and use of the relevant water resource (Figure 3). The Reserve *is the only water right specified as inviolable in the law* (DWAF, 1997). Water for basic human needs has the highest allocation priority in the country.

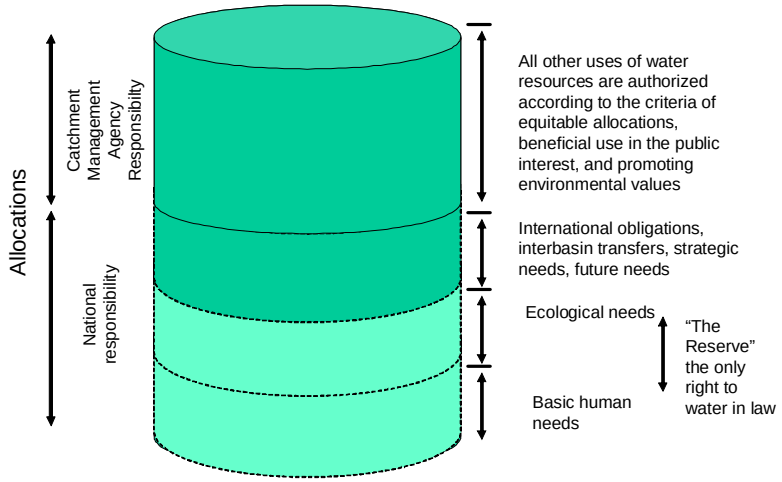

Figure 3: Conceptualisation of the Reserve (DWAF, 1999)

The *basic human needs Reserve*, includes water for drinking, food preparation and personal hygiene. The intention of the basic human needs Reserve is to secure the quality requirements for basic human needs with minimal treatment.

Apart from basic human needs, the only other right to water is the water quantity and quality required to protect aquatic ecosystems "…in order to secure ecologically sustainable development and use" of significant water resources (such as rivers, streams, wetlands, lakes, estuaries and groundwater) (DWAF, 2000). The intention of the *ecological Reserve* is to secure sufficient water of an appropriate quality to maintain aquatic ecosystems in such a form that they can continuously provide the desired set of socio-economic goods and services to society. The intention is not to protect ecosystems per se.

The objective of the Reserve is to serve the needs of the people who depend on ecosystem-based goods and services (Van Wyk *et al.,* 2003).

- ***Resource Quality Objectives*** *(RQOs):* RQOs are "clear goals relating to the quality of the relevant water resources" set in accordance with the management class that has been selected for that resource, and may relate to water quality, water quantity, or the integrity of the aquatic ecosystems. They are objectives for controlling impacts on the water resource through regulatory measures such as licensing of water use. It is formally the Department's responsibility to comply with RQOs, not individual water users.

  Resource Water Quality Objectives (RWQOs) are the water quality component of the Resource Quality Objectives (RQOs). The RWQOs outline both water user needs with respect to water quality, as well as their needs with respect to the disposal of water containing waste to the resource (DWAF, 2003).

The NWA (36:1998) ultimately aims that before a water use can be considered for licensing, it is necessary to determine and take into account the *class, Reserve and Resource Quality Objectives* (collectively referred to as Resource Directed Measures) for the relevant water resource unit(s) (NWA (36:1998) 17(1)(b)).

3.2.2 Source Directed Controls

Chapter 4 of the NWA (36:1998) contains provisions on *Source Directed Controls* (SDC). These deal with the regulation of water use. SDC focus on managing the quality and quantity of water **entering a water resource** with the primary purpose of ensuring that the objectives that have been set for the water resource (typically defined by the management class and RQOs) are achieved. SDC include regulatory mechanisms such as water quality standards for waste water, waste water discharges, pollution prevention, and waste minimisation technologies. Additionally, progressive implementation of self-regulation is encouraged. Economic incentive mechanisms are also implemented (DWAF 1997).

The authorisation of a water use (through a licence) is an important SDC. The purpose of a licence is to (a) ensure that water is used for the authorised purpose(s) only, and (b) enable the Department to achieve its water resource management objectives (such as RQOs), and hence contribute to sustainable development.

Individual licence conditions must also (a) be within the Department's ability to monitor, manage, and enforce, (b) not impose unreasonable demands on the licensee, and (c) have a purpose that is clear both to the licensee and to the Department.

3.2.3 Link between RDMs and SDC

Source directed controls (SDC) aim to control and minimise potential impacts on the water resource so that resource protection objectives (such as RQOs) are achieved. Licence conditions and monitoring as part of SDC, as well as RDMs, facilitates the auditing of the appropriateness of RDMs and SDC. This relationship is illustrated in Figure 4.

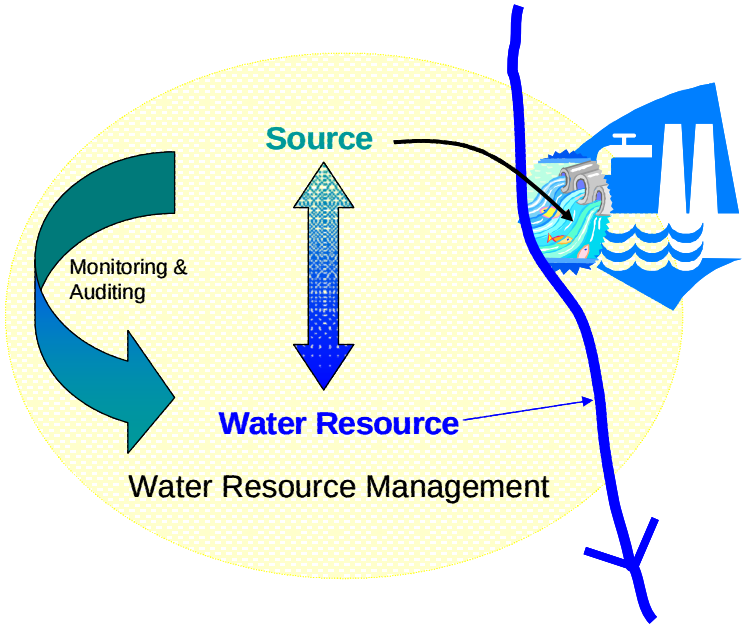

Figure 4: The relationship between RDMs and SDC

In the context of water use licence conditions, resource directed measures (RDMs) - the resource management class (the desired future state) aligned with the catchment vision, and the Reserve and resource quality objectives (RQOs) - are relatively new concepts. This document addresses the issues around formulating appropriate licence conditions that will ensure that they are given effect specifically in the context of resource directed management of water quality.

4. Overview of Content: Water Resource Planning System Series (Sub-series No. WQP 1)

4.1 Focus and Objective

The RDMWQ sub-series focuses specifically on the *water quality aspect* of the *water resource* and provides guiding principles and methods on:

- Various facets of the resource-based management of water quality;
- Determining the water quality requirements of the resource; and
- Incorporation of these into decision making regarding source-directed water quality management.

The objective of the Series is to facilitate the integration of the source and resource directed management approaches in an uniform and structured manner.

4.2 RDMWQ Framework for making Resource Directed Measures operational in licensing

The Sub series forms part of the iterative RDMWQ framework for making Resource Directed Measures operational in licensing, provided as Figure 5 and consist of the following volumes:

Volume 1: RDMWQ Policy (Colour coded: Orange)

The RDMWQ policy consists of a summary policy (colour coded: peach) and the detailed policy (colour coded: orange).

The Policy documents pertain specifically to the management of the use and protection of the water quality component of inland water resources, including surface watercourses, groundwater, estuaries and wetlands. These documents also address how the "resource directed" management of water quality should influence the management of anthropogenic activities that modify the water quality in water resources.

A strong emphasis has therefore been given in the policy to the underlying principles of water resource management and the clear description of underlying principles allows concise yet powerfully comprehensive policy statements to be made. The principles are, in effect, 'the rules of the game'

Volume 2: RDMWQ Strategy (Colour coded: Green)

The objective of the Strategy is the implementation plan for the Policy. It addresses "who should do what by when", explicitly linking the Policy to management approaches and management instruments to facilitate its practical and pragmatic implementation. It is also the intention that, in some contexts, this strategy presents a first-level interpretation of the policy.

Volume 3: Institutional Arrangements for RDMWQ (Colour coded: Purple)

A number of additional challenges will be faced with the decentralisation of Departmental functions to Catchment Management Agencies (CMAs) in cooperation with other water sector institutions, particularly related to changing institutional structures and arrangements, and the shifting roles and responsibilities.

This report focuses on institutional and organisational issues, with the objective of clarifying roles and responsibilities. While the discussion is aligned with the specific areas of focus of the RDMWQ project, it has to engage the broader water quality (and in fact the water resources management) environment.

Volume 4: RDMWQ Management Instruments (Colour coded: Navy Blue)

The Management Instruments refer to the suite of management instruments that have been developed as part of the RDMWQ sub-series to assist the Regional Offices, proto-CMAs and in future CMAs to make the *water quality* component of Resource Directed Measures operational in licences and to assist the Department with the evaluation and issuing of licences.

The management instruments to be developed were identified through a two-day workshop with representatives of the Regional Offices and the relevant directorates within the Department. Several officials and specialists were consulted throughout the development process of these instruments.

A first edition of management instruments was initially developed as prototype protocols. These instruments were subsequently improved upon, resulting in the development of the suite of second edition management instruments. Thus only those first edition management instruments that do not have a second editions have been published.

Volume 4.1: Guideline on Catchment Visioning for the Resource Directed Management of Water Quality (Colour coded: Blue)

One of the first step in the RDMWQ framework is the development of a catchment vision. Consequently, the first management instrument in the Management Instruments suite is a guideline for the generation of a catchment vision and goals to inform the water allocation process. This Instrument describes a practical process for developing a catchment vision and for disaggregating this vision into component management objectives through the hierarchical objectives approach.

Volume 4.2: Guideline for determining Resource Water Quality Objectives (RWQOs), Allocatable Water Quality and the Stress of the Water Resource (Colour Code: Light Blue)

The aim of this Guideline is to provide a practical, consistent approach to the determination of RWQOs, by integrating the results of the Catchment Vision, Resource Classification and Reserve, with other user sector requirements, as well as an approach to operationalise these RWQOs when evaluating licence applications. The guideline further provides guidance on determining the level of stress within the water resource and the allocatable water quality. This Guideline is supported by the RWQOs Model and User Guide to streamline implementation.

Volume 4.3: Guideline for Monitoring & Auditing for resource directed management of water quality (Colour Code: Sky Blue)

This document provides guidelines for the monitoring that is required for resource directed management of water quality. It is one of many essential management tools required to implement the Strategy and ultimately the Policy. The guideline provides guidance on how to design a water quality monitoring programme, introduces a long-term monitoring vision for RDMWQ, and provides guidelines for managing performance monitoring.

Appendices to the RDMWQ Series

The following project documents are provided as Appendices to the Sub-series WQP 1 for further information:

Appendix A: Resource Directed Management of Water Quality: Philosophy of Sustainable Development

Appendix B: Conceptual Review of water use licence applications in the context of the Resource Directed Management of Water Quality

Appendix C: Guidelines for Setting Licence Conditions for Resource Directed Management of

Water Quality

Appendix D: ACWUA - Decision-making Support System for RDWQM

Appendix E: RDMWQ Glossary

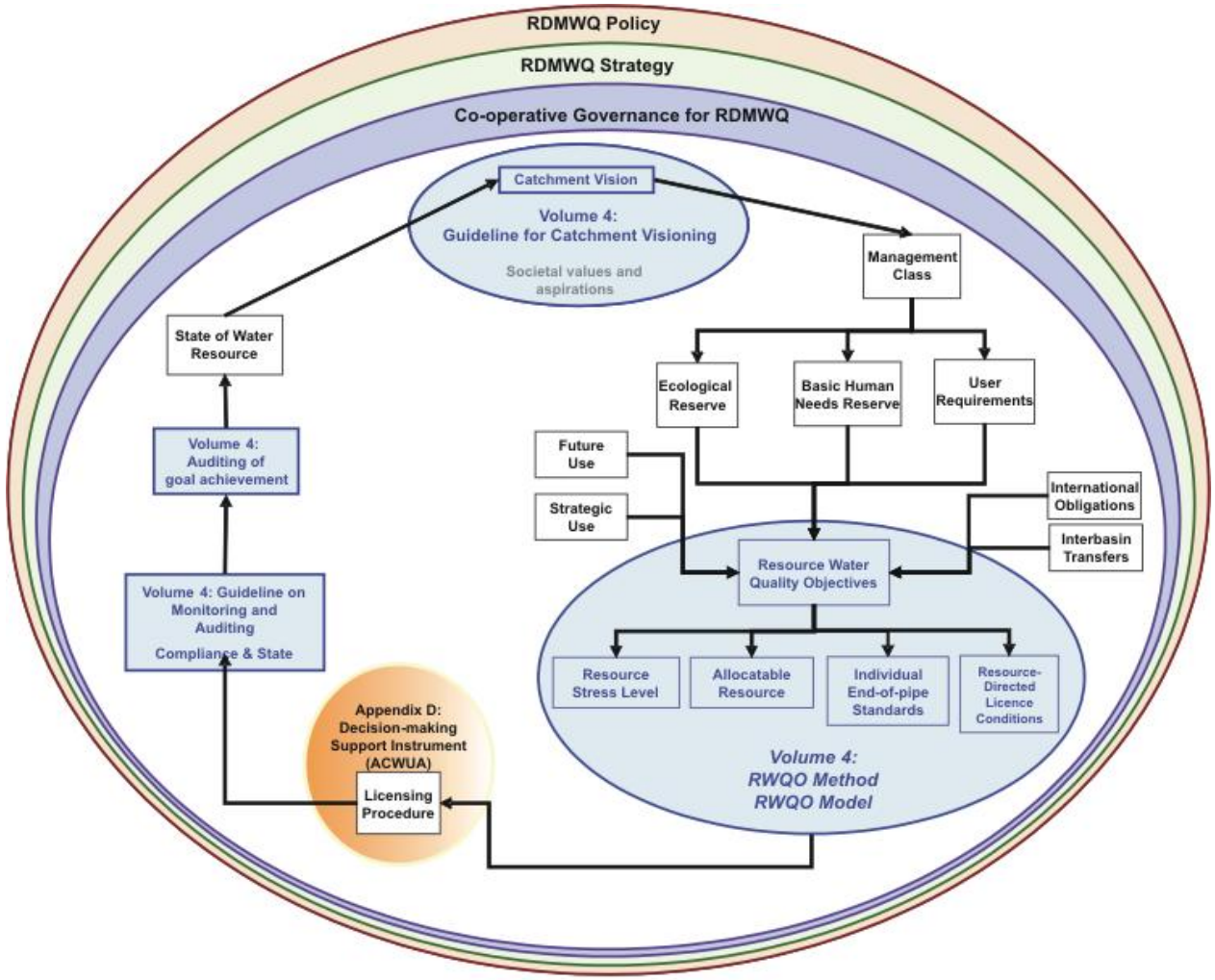

Figure 5: RDMWQ Framework for making RDMs operational in licensing (adapted from DWAF, 2006c).

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ISBN No: 0-621-36786-9
RP176/2006