

**Water Quality
Management Series**

SUB-SERIES No. MS 8.1

**A CONCEPTUAL INTRODUCTION TO THE NATURE
AND CONTENT OF THE WATER QUALITY
MANAGEMENT AND ASSESSMENT COMPONENTS
OF A CATCHMENT MANAGEMENT STRATEGY**



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PREFACE

Reform of South African water resource management has been a key focus of the Department of Water Affairs and Forestry (DWAF) for a number of years. This reform process has already seen a number of highlights, prime amongst which was the formulation of a new National Water Policy in 1997 and promulgation of a new water statute, the National Water Act (Act No. 36 of 1998). These developments established, *inter alia*, a formal process of integrated water resource management according to 19 Water Management Areas (WMAs). At the national scale, this process of integrated management is now structured by a National Water Resource Strategy (NWRS), while evolving Catchment Management Strategies (CMS) provide an integrated management framework at the catchment scale.

Sound strategies for catchment management require relevant information about the *water-related* natural attributes, infrastructure developments, human and ecological needs, human impacts, issues and economic development in a catchment. The process of collating, processing and interpreting such information in a water-related context is now generally called a "catchment assessment study". Although various forms of catchment assessments (sometimes called "situation analyses" or "basin studies") have been common-place in South African water resource planning for some time, a number of diverse approaches have been followed which have not necessarily been of comparable standard and consistency. Furthermore, the particular mix of information needs that statutory strategy development invokes, brings new challenges in the field of water resource decision support.

In such a new and evolving management environment, consistency and acceptable standards of both strategy development and supporting information might easily suffer. Therefore, a clear need has arisen for guiding procedures to support the processes and decisions involved. (It should also be noted that Section 10(1) of the National Water Act enables the establishment of such "guidelines" for the preparation of Catchment Management Strategies.) DWAF has responded to this need by initiating processes to develop a range of guideline documents in the integrated water resource management and catchment management fields. This document is one of a trio of inter-related documents specifically aimed at the domain of *water quality management*:

- ◇ *A Conceptual Introduction to the Nature and Content of the Water Quality Management and Assessment Components of a Catchment Management Strategy*
- ◇ *A Guideline to the Water Quality Component of a Catchment Management Strategy*
- ◇ *A Guide to Conduct Water Quality Catchment Assessment Studies.*

The development of these documents was informed by interviews with knowledgeable professionals operating in the water resource management field, as well as by the proceedings and outcomes of two dedicated Technical Workshops. The development process was guided by a Steering Committee under my guidance and with the support of the Director: Catchment Management of DWAF. A series of three Training Workshops, using an early draft of these documents, were also conducted with Regional Office staff in three different regions of the country. Valuable comments and insights, contributed by the Training Workshop participants, were incorporated in the documents.

Comments from those using these three documents in the future will assist their revision and ongoing improvement. The documents will also be used for continuing capacity building and training and for conceptual and technical support to the unfolding implementation of the National Water Act.



JLJ van der Westhuizen
Director: Water Quality Management

DOCUMENT INDEX

Reports as part of this Sub-Series:

Sub-Series No.	Report Title
MS 8.1	A Conceptual Introduction to the Nature and Content of the Water Quality Management and Assessment Components of a Catchment Management Strategy (this document)
MS 8.2	A Guideline to the Water Quality Management Component of a Catchment Management Strategy
MS 8.3	A Guide to Conduct Water Quality Catchment Assessment Studies: In Support of the Water Quality Management Component of a Catchment Management Strategy

Other relevant DWAF Reports:

- RSA Department of Water Affairs and Forestry, 2001. Integrated Water Resource Management Series, Sub-Series No. MS 6.1, *Guidelines on the Establishment and Management of Catchments Forums: in support of Integrated Water Resource Management*. Pretoria.
- RSA Department of Water Affairs and Forestry, 2001. Integrated Water Resource Management Series, *Generic Framework for Catchment Management Strategies (Draft)*. Pretoria.
- RSA Department of Water Affairs and Forestry, 1999. DWAF Report No. WQP 0.1. *A Framework for Implementing Non-Point Source Management under the National Water Act*. Pretoria.

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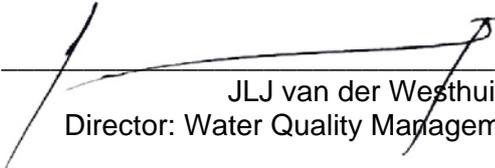


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ACRONYMS

CMA	- catchment management agency
CMS	- catchment management strategy
DEAT	- Department of Environmental Affairs and Tourism
DWAF	- Department of Water Affairs and Forestry
DWAF HO	- DWAF: Head Office
DWAF RO	- DWAF: Regional Office
NPS	- non-point source
IWRM	- integrated water resources management
ISD	- institutional and social development
NWA	- National Water Act (Act No 36 of 1998)
NWRS	- national water resource strategy
RDM	- resource directed measures
RQO	- resource quality objectives
RWQO	- resource water quality objectives
SMO	- source management objectives
WMA	- water management area
WMI	- water management institution
WQ	- water quality
WQCAS	- water quality catchment assessment study
WQM	- water quality management
WSI	- water services institution
WRM	- water resources management
WSA	- water services authority
WSP	- water services provider
WQCMS	- water quality component of a CMS
WUA	- water user association

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1 What is the Purpose of this Document?

This document outlines a conceptual description of the nature and content of a Catchment Management Strategy, with an emphasis on the water quality management component. Although this water quality management approach was formulated parallel to the *Generic Framework for Catchment Management Strategy* (DWAF, 2001), it is broadly consistent with this framework. It provides more detail in terms of the water quality management and catchment assessment components. In particular it provides philosophical support for the:

- *Guideline to the Water Quality Management Component of a Catchment Management Strategy (CMS)*; and
- *Guide to Conduct Water Quality Assessment Studies: In Support of the Water Quality Management Component of a CMS*.

This introductory document is written to engage the ongoing debate around the formulation of Catchment Management Strategies in South Africa, as required by the National Water Act (Act 36 of 1998). This document is not intended to be an exhaustive treatment of the subject, but rather to highlight some of the issues that require further analysis and coherence. A conceptual framework is developed, noting that Catchment Management Strategies are likely to differ and evolve progressively according to the characteristics of the Water Management Area for which they are developed.

Although the document focuses on water quality management, this does not imply that water quality should be divorced from the quantity and ecological components of resource quality. Rather, for these components similar guidelines should be developed, linking into the generic framework and the water quality-oriented approach.

2 What is Catchment Management in South Africa?

2.1 The Overarching Policy Principles for Catchment Management

One of the most important milestones in the revision of the Water Law in South Africa was the publication of the *White Paper on a National Water Policy for South Africa*. This document highlighted the overarching policy considerations for water resources management, which were later taken up into the National Water Act (NWA) (Act 36 of 1998). The most important components of these were the requirements to ensure sustainable use of water resources and the equitable use¹ of the resource for the “optimum social and economic benefit” of the country. Coupled with these were the need for a transparent and participative approach to water resources management, and the need to provide for a “Reserve”. The “Reserve” is that quantity and quality of water required for basic human needs, as well as that quantity and quality required to sustain aquatic ecosystems.

These overarching policies must underlie the approach to water resources management on a catchment basis. Catchment water quality management is a component of this process, and as such is subject to these policy principles. These principles have therefore been integrated into the *Guideline for the Water Quality Management Component of a Catchment Management Strategy*, the sister-document to this introductory one (Sub-Series No. 8.2). These principles should consequently be considered as inherent to all the steps proposed in that document, even where not explicitly stated as such.

2.2 The National Water Resource Strategy

Chapter 2 of the National Water Act (NWA) makes provision for the development of a national water resource strategy (NWRS). The NWRS gives effect to integrated water resources management at a national strategic level, by providing a framework for water resources management between and within Water Management Areas (WMAs). The NWRS therefore makes provision for the water quality and quantity requirements of strategically important water users. The NWRS is established in law and may consist of a number of functional and/or issue-based strategies for the protection, use, development, conservation, management and control of water resources.

The development of the NWRS is still in a provisional mode and the form and content of the associated strategies, objectives, plans, guidelines and procedures is as yet evolving. However, the NWRS must “state the objectives in respect of water quality to be achieved through the classification system” [Section 6(1)(i)]. Together, the quantity-related aspects of the NWRS and resource protection (see below) provide the constraints for water quality management within a WMA.

Catchment Management Strategies (CMSs) must give effect to the NWRS within WMAs, and the NWRS thus provides the framework within which a CMS should be developed. The NWA also indicates that all water resources management activities must give effect to these strategies.

¹ Most importantly “Use” as defined in the National Water Act includes *inter alia* the consumptive use of the resource, as well as use of the resource for the discharge of water that contains waste.

2.3 Resource Protection

The NWA is grounded in the *resource protection* approach, based upon resource directed measures and source directed controls, which are not prescribed by law, but have to be developed through Department of Water Affairs and Forestry (DWAF) policies. Resource directed measures aim to provide an appropriate level of protection for different water resources. This system allows for the ecological classification of water resources into four Classes, describing relatively pristine to highly degraded (ecologically dysfunctional) resources. These ecological Classes may be combined with the socio-economic importance of the resource to formulate management classes reflecting the required level of protection. These Resource Management Classes will focus management attention on sensitive or degraded systems, and may indicate standards and practices required to control pollution at source. In some cases, they will highlight the need for remediation, either of the water resource itself, or the sources causing water quality problems.

The classification system will also establish Resource Quality Objectives (RQOs) for each water resource. These RQOs specify numeric and narrative objectives that may relate to quantity, quality, habitat, biota or instream / land-based activities for different water bodies. This is done in terms of the requirements of the "Reserve", and in terms of the needs of other users. These RQOs therefore set the "line in the sand" with respect to water quality management goals, and shift the emphasis of water resource protection into the water resource. Most importantly, the National Water Act requires that all water resource management practices "give effect" to these RQOs and the water resource classification system.

The water resource classification system may [Section 12(2)b]:

- (i) *establish procedures for determining the Reserve;*
- (ii) *establish procedures which are designed to satisfy the water quality requirements of water users as far as is reasonably possible . . .;*
- (iii) *set out water uses for in-stream or land-based activities which must be regulated or prohibited in order to protect the water resources.*

The determination of a Water Resource Management Class, the RQOs and the Reserve for a water resource occurs outside of the NWRS (although the results are reflected in the NWRS). Similarly, Classification can proceed outside of the formulation the CMS (although the CMS must give effect to the Classes). However, Classification of water resources, when at least done in parallel with the formulation of the CMS, will add value to both the Classification and Catchment Management processes.

2.4 Water Use

Water use is broadly defined in Section 21 of the NWA to include:

- (a) *taking water from a water resource;*
- (b) *storing water;*
- (c) *impeding or diverting the flow of water in a watercourse;*
- (d) *engaging in a stream flow reduction activity contemplated in section 36;*
- (e) *engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);*
- (f) *discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;*
- (g) *disposing of waste in a manner which may detrimentally impact on a water resource;*

- (h) *disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;*
- (i) *altering the bed, banks, course or characteristics of a watercourse;*
- (j) *removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and*
- (k) *using water for recreational purposes.*

Those that are particularly relevant for catchment water quality management are *Sections 21(e), 21(f), 21(g), 21(h) and 21(j)* while *Sections 21(d), 21(i), 21(k)* relate particularly to instream and riparian activities.

2.5 Resource Quality and Water Quality

The National Water Act defines Resource Quality (RQ) as [Section 1(xix)]:

...the quality of all the aspects of the water resource including –

- (a) *the quantity, pattern, timing, water level and assurance of instream flow;*
- (b) *the water quality, including the physical, chemical and biological characteristics of the water;*
- (c) *the character and condition of the instream and riparian habitat; and*
- (d) *the characteristics, condition and distribution of the aquatic biota.*

This definition extends the conventional interpretation of water resources to represent the entire aquatic ecosystem, rather than mere water quantity and quality. Accordingly, the *interrelationships* between the four elements of RQ are as important as the elements themselves. As such, the concept of RQ is a keystone of integrated water resource management (IWRM), and hence of Catchment Management.

Management of Resource Quality requires management of water quantity, water quality and aquatic ecosystem quality. Functionally, water quantity and quality have been separated in the DWAF. While this document has been prepared as a Guideline for the water quality component of a CMS, the approaches outlined are appropriate for managing the water quality requirement of the habitat and biotic components, and could be integrated with the quantity component of a Catchment Management Strategy.

2.6 Institutional Arrangements

The White Paper on a National Water Policy states that the National Government is “custodian of the nation’s water resources and its powers in this will be exercised as a public trust”. DWAF is the primary agency responsible for water resources management. In exercising its mandate, DWAF must reconcile, integrate and coordinate diverse and often conflicting interests of different stakeholders, within the framework of sustainable and equitable utilisation of South Africa’s water resources.

The new policy also provides for the phased establishment of Catchment Management Agencies (CMAs) to undertake IWRM in defined WMAs. CMAs will be responsible for implementing the statutory provisions of the Act, as well as developing CMSs in their WMA, in line with the NWRS. However, only the Minister and DWAF can establish institutions, delegate powers, or promulgate statutory authorisations, requirements or strategies. Many of the personnel in these CMAs may not be highly skilled, due to the human resource limitations in South Africa. This reinforces the need to adopt streamlined approaches for water resources management.

2.7 The Catchment Management Process

The process of catchment management has been outlined in the document, *Guidelines for Catchment Management to Achieve Integrated Water Resources Management in South Africa* (Görgens *et al* (1998)). Stakeholder consultation and participation underlies the entire process and is therefore not explicitly identified as a stage of catchment management. This is a critical component of the development of a CMS, and must ensure “buy-in” and “ownership” by the stakeholders. However, consultation around water quality management issues must be part of the entire CMS development process, and should link to the processes of CMA establishment and/or operation.

The Catchment Management process generally involves the following stages, although these are characterised by significant overlap and iteration:

- *initiation*: of the catchment management process, triggered by one or more water-environment related issues;
- *assessment*: to provide understanding of the water, social, economic and institutional environments;
- *planning*: for catchment management in that area, resulting in a catchment management strategy;
- *implementation*: of the actions and procedures detailed in catchment management strategy;
- *administration*: of the catchment in terms of the catchment management strategy, including fine-tuning;
- *monitoring*: and processing of data and information collected in the catchment; and
- *auditing*: of catchment management against performance indicators, and regular review of the strategy.

Note

A Catchment Management Strategy may (and will most likely) be established in a phased and progressive manner, based on the water resource management priorities in different parts of a WMA. The first edition Strategy may therefore only include parts of a comprehensive strategy, but should specify a Plan for the development of future strategies. These initial parts of the CMS may be geographically-based (in priority sub-catchments, or “Management Units”) or issue-based (for priority water resource management problems or concerns).

3 What are Possible Components of a CMS?

3.1 Introduction

The document, *Generic Framework for Catchment Management Strategies* (DWAF, 2001), provides an interpretation of the nature and content of a CMS. This is taken as the point of departure for this document and the associated guidelines, together with the minimum requirements of a CMS outlined in Section 9 of the NWA.

This section unpacks the statutory and pragmatic requirements of a catchment management strategy (CMS), and its implications for the water quality management component.

3.2 The Requirements of Section 9 of the NWA

Each catchment management agency (CMA), or the DWAF Regional Office acting as a CMA where one is not yet functional, is required to progressively establish a catchment management strategy and review it at least every five years.

Section 9 of the National Water Act (Act 36 of 1998) states the requirements of a CMS. However, it is useful to reorder these requirements, in order to provide some structure and facilitate interpretation. A possible paraphrased reordering is as follows:

Given the...:

- *Requirements and constraints of the national water resources strategy (Section 9b);*
- *Requirements of the water resources management class, resource quality objectives, the Reserve and international obligations (Section 9a);*

The national water resource strategy and resource directed measures are developed externally to the CMS, also through a process of stakeholder consultation. They provide the framework and constraints within which water resources in a Water Management Area (WMA) will be managed (in other words, the context in which the CMS will be developed). In particular, the CMA must give effect to the requirements and objectives outlined in the NWRS and the resource directed measures (namely the class, Reserve and RQOs).

And considering the...:

- *Natural and anthropogenic character of a WMA, ie. geology, land use, etc (Section 9d);*
- *National and regional plans, including water services development plans (Section 9f);*
- *Needs and expectations of existing and future water users (Section 9h);*

These provide the background to and must be reflected in the CMS, but are not necessarily the focus of the CMS. However, they represent the basis of the catchment assessment supporting the development of the CMS. The linkage to other plans is important in terms of cooperative governance and coordinated planning for the CMA, while the needs and expectations of users is important in terms of public participation in water resources management.

The CMS must set out the...:

- *Strategies, objectives, plans, guidelines and procedures of the CMA (Section 9c);*
- *Allocation plan, reflecting the principles for authorising water use (Section 9e);*
- *Institutions to be established (Section 9i):*

This is the core of the CMS, as required by the National Water Act. However, other components that are not specified may also be core components of the Act, as outlined below in this document.

The first bullet represents the main vehicle for setting out the approach to water resources management in a WMA. These strategies, objectives, plans, guidelines and procedures should focus on the requirements for giving effect to the resource directed measures (RDM) and the national water resource strategy (NWRS). They may address technical management issues, as well as stakeholder participation, institutional development and resource allocation for water resources management.

The allocation plan represents an important water resources management component of the CMS. It should take cognisance of water quantity, water quality and habitat-biotic issues, thereby providing the linkage between RDM and water use. The allocation plan is usually narrowly interpreted as addressing the allocation of water quantity. However, with the broad interpretation of water use under the NWA, a similar plan should be formulated for the allocation of water quality related uses. This may be referred to as a *water quality allocation plan*, and should provide the basis for statutory authorisation of point and nonpoint sources. The formulation of these allocation plans must give effect to the allocation provided for in the NWRS, taking account of the principles for water use authorisation presented in Section 27 of the Act².

The institutional arrangements should reflect the water resource management needs in the catchment, including the specific functional requirements for managing water quality in the WMA. In setting out the institutions, some indication of their organisational development must be provided, and thus the strategy provides the link between priority water resources issues and institutions required for their management. This requirement implies that the CMS represents a “business plan” for water resources management in a WMA³. It should include the development of institutions to facilitate the participation of stakeholders in water resources management decisions within a WMA.

To enable the...:

- *Public to participate in managing water resources in their WMA (Section 9g);*

This is central to the purpose of catchment management as described by the CMS, and is a key objective of the establishment of CMAs and associated institutions. However, in the interests of integrated water resources management, it must not be separated from the general stakeholder participation and consultation associated with the development of a CMS, nor the stakeholder involvement in the establishment of a CMA. This requires adoption of the concept of stakeholder involvement, participation and consultation in any

² This requires an interpretation of the social, economic and ecological imperatives that must be addressed in allocating water.

³ The concept of a “water resources management business plan” should not be confused with the statutory requirement of an annual business plan for particular water management institutions, such as catchment management agencies or water user associations.

catchment management process, as being the core of an institutional development capacity building process.

For water resource...:

- Protection, use, development, conservation, management and control (Section 9c).

These six activities⁴ represent the main purpose of catchment management as outlined by the CMS, namely to ensure integrated water resources management (IWRM) at a catchment level.

3.3 The CMS as a Process

As highlighted above, the CMS is both a process and a framework. The dynamic or procedural nature of the strategy is associated with the following three characteristics:

- The “phased and progressive” nature of a CMS (and the NWRS with which it must be consistent), implies that components of the CMS may be continually being developed, implemented and revised (on a five-year cycle).
- The CMS must give effect to potentially time-varying RQOs, which implies that the strategy itself must be time-varying and dynamic.
- The cause-effect relationships between water resources management actions and the quality of the water resource are not always clear, which implies that the strategy must be self-correcting and must incorporate a dynamic feed-back mechanism.

Without minimising unnecessarily the challenging process required for developing, implementing and revising the CMS, the *dynamic* nature of the CMS may be reflected in Figure 1.

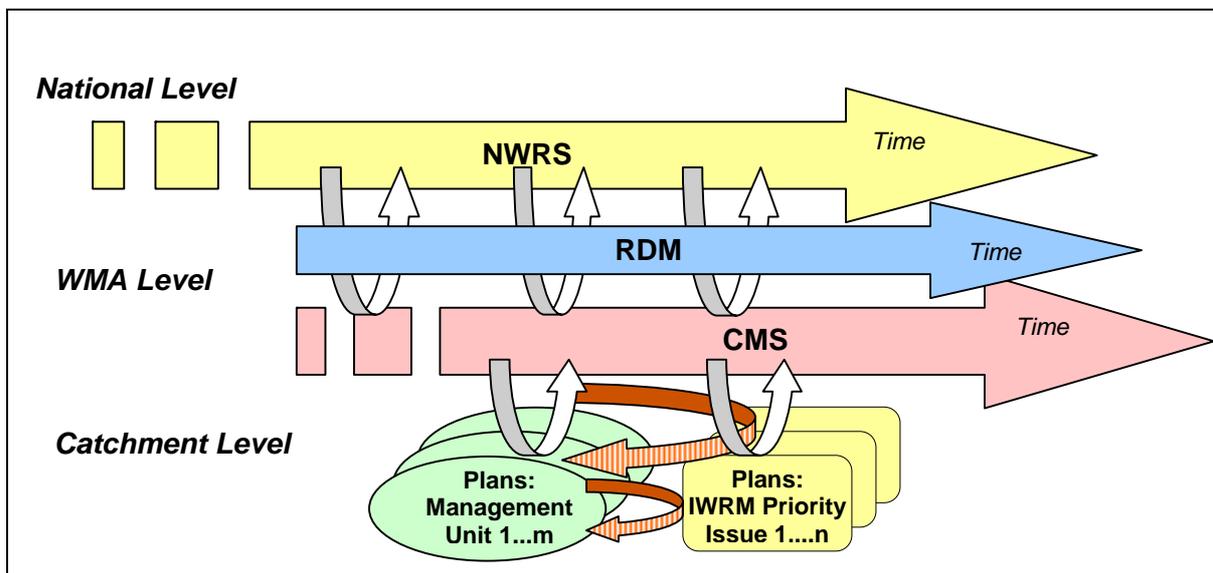


Figure 1: Illustration of the Dynamic and Inter-Related Nature of a CMS (Plans indicated cover Water Quantity, Quality, and Aquatic Ecosystem Components)

⁴ The exact interpretation and differentiation of these management activities is not actually important, rather they should be seen together as representing all integrated water resources management.

3.4 The Role of a CMS

The Catchment Management Strategy provides an opportunity for water management institutions and stakeholders to formulate a coherent approach (and “intent”) for managing the water resources in a WMA. As such the CMS should be viewed as both a *process* and a *framework* for management (see below for an explanation of this concept), which binds DWAF and the CMA, as well as the water users, stakeholders and their representative structures in a social and/or legal “compact”. The CMS must not be seen as only DWAF’s or the CMA’s strategy, and the creation of this broad responsibility should be the primary focus of the participation process to develop a CMS.

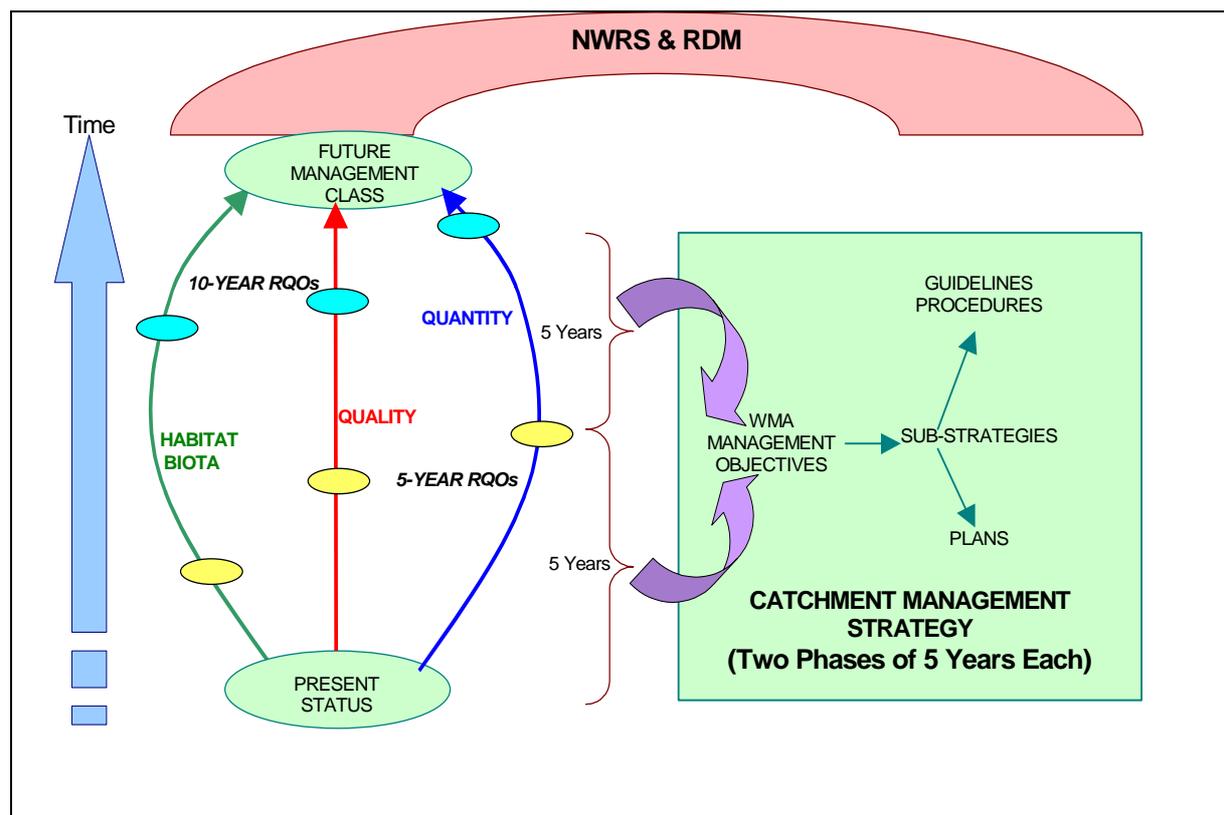
However, the CMS must be more than an analysis of water resources management problems and a wish-list of proposed solutions. Rather, it should be a holistic and comprehensive “business-plan” for integrated water resources management in the WMA, which focuses on priority water resources management issues, and specifies the activities, resources, responsibilities, timeframes and institutions required to address these priority issues in an efficient and sustainable manner. Therefore, the CMS is simultaneously a technical water resources management strategy, an organisational-institutional development strategy and a stakeholder participation-communications strategy.

Despite this fairly broad scope, it must be reiterated that the ultimate aim of the CMS is to facilitate integrated water resources management in a WMA, in accordance with the purpose outlined in *Section 2* of the Act. In other words, any part of the strategy should be “tested” against these principles, which may be summarised as requiring:

- *sustainable* utilisation of water resources, implying no irreversible ecological degradation;
- *equity* in the allocation of water, and its benefits and services;
- *redress* of past discrimination and inclusion of historically marginalised groups;
- optimal beneficial use of water, implying social and economic *efficiency* in its allocation to promote development;
- *participation* by all relevant water users, stakeholders and communities.

Together these principles reflect the requirements of the ecological, social and economic components of water resources, considering South Africa’s historical legacy of inequality. It is not accidental that these three components are generally accepted to be the fundamental considerations for sustainable natural resource utilisation. The greater the convergence between ecological, social and economic requirements, the greater the likelihood of sustainable resource use, or in the case of catchment management, sustainable water use.

The CMS must give effect to the relevant elements of the national water resource strategy and the resource directed measures for the WMA. In this context, it is important to note that resource quality objectives (RQOs) are time-related management goals reflecting a path leading to an agreed future state, as specified by the water resource management Class. The relationship between the RQOs (and NWRS) and the CMS is illustrated in the Figure 2.



Chapter 3: Possible Components of a CMS

Figure 2: Illustration of Relationship Between Time-Referenced RQOs and the CMS

The process of determining the water resource management Class and associated RQOs, is also based on stakeholder participation and “consensus-seeking”. It attempts to balance the socio-ecological need for protection with the socio-economic needs for development and utilisation of the water resource, taking account of national strategic ecological, social and economic interests.

The preceding discussion raises some pertinent issues for the CMS, which initially seem to be paradoxes.

- The establishment of the Catchment Management Strategy must be a dynamic process, adjusting to changing circumstances within a WMA, but it must also provide the “solid” framework and implementation programme that is required to achieve identified management goals.
- The strategy may be developed in a “phased and progressive” manner, which implies the development of separate area-based or issue-based components, but must ensure integrated management of all components of the water resources in a WMA.
- The CMS must provide a framework for integrated water resources management within an entire Water Management Area, but must capture/channel local energy and facilitate localised action by stakeholders to address critical local issues, to ensure effective and sustainable management and stakeholder participation-interest.
- The CMS has a statutory nature, in that it may be legally established, but it provides the opportunity for stakeholders to formulate broad programmes of action that are non-statutory and based on negotiated public agreements.

3.5 A Conceptual Structure of a CMS

Figure 1 indicates a possible conceptual structure for the CMS, in giving effect to the NWRS and RDM for a WMA. It implies that the CMS should be conceptually separated into two levels (reflecting different spatial scales/ time frames), namely the:

- *WMA-wide CMS itself*, comprising a WMA-wide Framework of “Component Strategies”, which states the principles for, the dynamic objectives of, an inventory of, and the linkages with/ between all four Resource Quality Components of the CMS [Quality, Quantity and Aquatic Ecosystem (Habitat & Biota) management], as well as with and between a range of other Component Strategies and Implementation Plans for IWRM, to address the priority issues within different parts of the WMA, as well as their relationships with the NWRS and RDM.
- *Catchment-Level Implementation Plans*, which detail the plans, protocols and implementation programmes required to give effect to the CMS Framework Component Strategies at (sub-) catchment scale, and assembled according to spatial “Management Units” and/or water user sectors and/or water-related issue categories (e.g. eutrophication).

The CMS process should facilitate the iteration and feed-back of information from the Catchment-Level Implementation Plans to the CMS Framework. The *process* of the CMS needs to engage all the generic phases of the water resource management cycle, namely *planning; implementation and development; operation and control; monitoring and auditing*.

The CMS must therefore provide a structure for these four phases, associated with all Component Strategies (or Plans) that are developed as part of the CMS. In doing this, it must allow for the dynamic nature of the evolution of Catchment Management in the WMA, while giving concrete direction for IWRM at localised levels.

The development of a CMS must give effect to the temporal and spatial pathway for water resource management that has been set out by the RQOs (see Figure 2). This may be grouped into *stressed, threatened* or *unstressed* catchments, although many WMAs will have one or more (sub-)catchments in each category. This approach may be the basis for developing a CMS, or, at least, prioritising (sub-)catchments for the implementation of the CMS.

It is worth interpreting the meanings of the terms, *Component Strategies, objectives, framework-plans, implementation plans, guidelines and procedures* in terms of their role in the CMS. For this document, the following interpretation is proposed:

- *Component Strategies* make up the *over-arching mosaic of the CMS* and outline the high-level IWRM requirements for the entire WMA. They include the following elements:
 - water resource-technical (e.g. Water Quality Management, Water Quantity Management and Aquatic Ecosystem Management Components – each with its own Framework-Plan that describes and directs the evolution of that Component, while maintaining the necessary integration with the other Component Strategies of the CMS),
 - institutional-financial (e.g. Institutional Development and Pricing Component Strategies, etc.),
 - participation-educational-advocacy-communications (e.g. Communications/Awareness-building Component Strategy, etc.),
 - monitoring-auditing-review (e.g. framework of monitoring, auditing and review criteria and procedures for Catchment Management).

It is essential for the purposes of sound communication with stakeholders that Component Strategies should be formulated and presented as over-arching WMA-wide approaches and in concise and straight-forward terms. The elaboration of details should be left to the respective Framework-Plans for the individual CMS Components of Quantity, Quality and Aquatic Ecosystems and their supporting Implementation Plans.

- *Objectives* represent the WMA-based management objectives required for the CMS to achieve the RQOs. They may provide key performance indicators for the CMS, and may relate to water use, institutions or finances, among others.
- *Framework-Plans* outline the WMA-wide approach to integrated management in each of the Resource Quality Management domains of *Quantity, Quality and Aquatic Ecosystems* and, as such, represent the heart of the CMS. It should specify the *strategic* approaches and plans for IWRM, the linkages to the other components of the CMS, the sectoral responsibility for formulating and implementing the water resource management actions required to meet the Reserve and the RQOs, an Implementation Programme and auditing arrangements.
- *Implementation Plans* give effect to the technical, institutional, participation or auditing Component Strategies at a (sub-)catchment scale, indicating the required management actions, responsibilities, timeframes and resources.
- *Guidelines* may provide statutory requirements or non-binding advice, supporting the implementation of the WMA strategies or the development of local plans.
- *Procedures* represent the institutional mechanisms for ensuring coordination and consistency in the implementation of the CMS Component Strategies and plans.

Thus, the main distinction is that the Component Strategies are dynamic WMA-level interventions, that are given effect by (sub-) catchment-level Implementation Plans. Any component of a CMS may be statutorily established, if this establishment is agreed to and supported by the relevant stakeholders, even if this is outside the mandate of DWAF or the CMA (such as cooperative agreements on land use management). Alternatively, the Implementation Plans may be non-statutory and, therefore, voluntary, but then the Plans should be based on agreed procedures to encourage compliance.

The characteristics of the components of the CMS at the two scales referred to above are briefly addressed in the following two sections.

3.6 WMA-Scale: CMS as a Framework for IWRM

The aim of the CMS Framework is to provide a dynamic description of the water resources management priorities and intent of all water management institutions and stakeholders *in the entire WMA*. In particular, it outlines the inter-relationships between the various components of the CMS, and provides a programme for developing and implementing these components.

As highlighted above, the CMS should be seen as a high-level “business plan” for IWRM in the WMA, and therefore the CMS Framework must engage technical, institutional and participatory issues.

The CMS Framework should begin with the *vision* for the WMA, expanding upon the specified Management Classes of the water resources in the WMA. A number of *guiding principles* should be developed from this vision and the purpose of the Act, which will be used during the development and evaluation of CMS Component Strategies and Plans. These guiding principles should indicate the way in which social, economic and ecological

imperatives will be considered to achieve sustainability, equity and efficiency of water resource use and protection. Associated guidelines should be provided to assist in the resolution of conflict over these issues during the development of Component Strategies and Plans.

The CMS Framework should be based on a strategic assessment of the water resources in the WMA⁵, through the analysis of an integrated water balance. This must be performed in more detail than the assessments supporting the NWRS, and should engage all elements of the water resource and water use. This assessment should inform the prioritisation of water resource management issues, which should then be reflected in the CMS Framework Document. The first edition of the CMS Framework Document should be formulated early in the process and should also specify the types of Component Strategies, implementation programmes and Plans that must be developed and the organisational responsibilities and resources that are required.

Typical Component Strategies (and associated objectives) in the CMS Framework would include⁶:

- NWRS and RDM (Class, Reserve and RQOs) Intervention Component Strategy
- Water Quantity Management Component of the CMS, including a Water Quantity Framework-Plan
- Water Quality Management Component of the CMS, including a Water Quality Framework-Plan
- Aquatic Ecosystem Management Component of the CMS, including an Aquatic Ecosystem Management Framework-Plan
- Water Resource Augmentation Component Strategy
- Water Resource Operating Component Strategy
- Water Demand Management Component Strategy
- Water Pricing Component Strategy
- Institutional Development and Cooperative Governance Component Strategy
- Capacity-Building Component Strategy
- Communications/ Awareness-Building Component Strategy
- Information Management and Monitoring Component Strategy
- Land Use Planning/ Management Component Strategy
- Monitoring, Auditing and Review Component Strategy

It follows that each element of the CMS should have either a focused Quantity/ or Quality/ or Aquatic Ecosystem Management sub-component (e.g. the Water Quality Management part of the Communications/ Awareness-Building Component Strategy), or technical cross-linkages to a Quantity/ or Quality/ or Aquatic Ecosystem Management consideration (e.g. the role of “freshening releases” in determining aspects of the Water Resource Operating Plan).

⁵ Tools, such as the Strategic Environmental Assessment (SEA), being developed by DWAF, may be used to support this strategic assessment.

⁶ The details of the CMS elements are not expanded upon in this guide – rather they are the topic of the *Generic Framework for Catchment Management Strategies* (DWAF, 2001 – see Document Index on page ii of this Document) and, for Water Quality Management, in the sister-document to this one: *A Guideline to the Water Quality Management Component of a Catchment Management Strategy* (Water Quality Management Series, Sub-Series 8.2, DWAF, 2003)

All these must be developed within a coherent structure, addressing issues of integration and overlap between Component Strategies, which must be developed as part of the CMS Framework. For example, it is critical for the success of catchment management that the relationship between institutional development, public participation, capacity building and communication (awareness creation) is clearly formulated. Similarly, from a water quality perspective, the relationships and interactions between plans for water use allocation, water quality management, nonpoint source management, financing, communications and cooperative governance need to be developed.

3.7 Catchment Scale Plans

The (sub-) catchment scale components of a CMS include the detailed plans, implementation programmes, systems, guidelines and procedures that give effect to the Component Strategies, on an IWRM issue basis and/or at a localised scale. These may be generically separated into those associated with technical water resources management issues and those associated with institutional and social development issues. Without going into detail, the following list highlights the types of possible plans, with an emphasis on water quality. It should be noted that this is not an exhaustive list, but is merely indicative.

Technical water resource management components

- *Water Quantity Use Allocation Plan*
- *Water Quality Use Allocation Plan*
- *Sector Management Plans*
- *Remediation Plan*
- *Reservoir-River System Operating Plan*
- *Monitoring Programme*
- *Information Management Plan*

Supporting institutional development components

- *Organisational Development Plans*
- *Capacity-Building Plan*
- *Education and Awareness Programmes*

The generic form and content of these plans should be similar, and should incorporate the following elements – presented in the form of a business plan:

- situation assessment
- definition of goals and objectives
- implementation (activities)
- operation (responsibilities, timeframe, resources)
- supporting and enabling tools
- auditing and performance review (key performance indicators)

4 The Water Quality Management Component of the CMS

The previous discussion has outlined a conceptual perspective of the CMS and various considerations for its development. In this chapter, these are briefly translated into the requirements of the water quality management (WQM) component of a CMS, as described in the sister-document to this one, *Guideline to the Water Quality Management Component of a Catchment Management Strategy* (see Footnote 6).

Water quality management takes place at a local level and therefore water quality management plans, decisions and actions are generally at a sub-catchment scale. However, these have implications for downstream users (and upstream impactors), which requires alignment of WQM approaches between sub-catchments within a WMA (and possibly between WMAs).

As indicated in the previous Chapter, the CMS must give effect to the requirements of the resource directed measures and the national water resource strategy. Together these establish the water quality, water quantity and aquatic ecosystem attributes that are required to ensure a given level of protection for the resource, to meet basic human needs, and to meet the requirements of strategically important water users. The process of developing a CMS may also identify stakeholders' needs with respect to use of the water resource over and above these requirements

In order to develop the WQM component of a CMS, the following approach has been proposed in the aforementioned *Guideline to the Water Quality Management Component of a Catchment Management Strategy*, comprising an iterative and incremental process that answers four generic questions, as outlined below:

What are the goals for water quality management?

- a. Establish WMA-wide *resource water quality objectives* to meet user requirements and for use of the resource to dispose of water containing waste, based on the needs expressed by the stakeholders.

How must water quality loads change to achieve the goals?

- b. Determine WMA-wide *source management objectives* to meet these needs.

How will this be managed across the WMA?

- c. Formulate a WMA-wide *water quality management framework-plan* that indicates the management priorities, requirements, CMS linkages, sectoral responsibilities and implementation programme to achieve these objectives.

How, where, by whom and when will this be implemented?

- d. Develop individual (sub-) catchment-scale *water quality management implementation plans*, which may be source-, issue- or sector-specific, or even, multi-sectoral, to give effect to the water quality management framework-plan.

Together, these make up the framework for the WQM component of the CMS. They will be revised and updated on a five-yearly basis to accommodate the ongoing development of the WMA, and are aimed at securing a gradual and phased realisation of the stakeholders' goals for individual catchments in the WMA.

Figure 3 shows conceptually how these four steps allow for the gradual realisation of the stakeholders' goals - according to individual sub-catchments, or spatial "Management Units" - in the WMA, by harnessing the collective resources available at a local level.

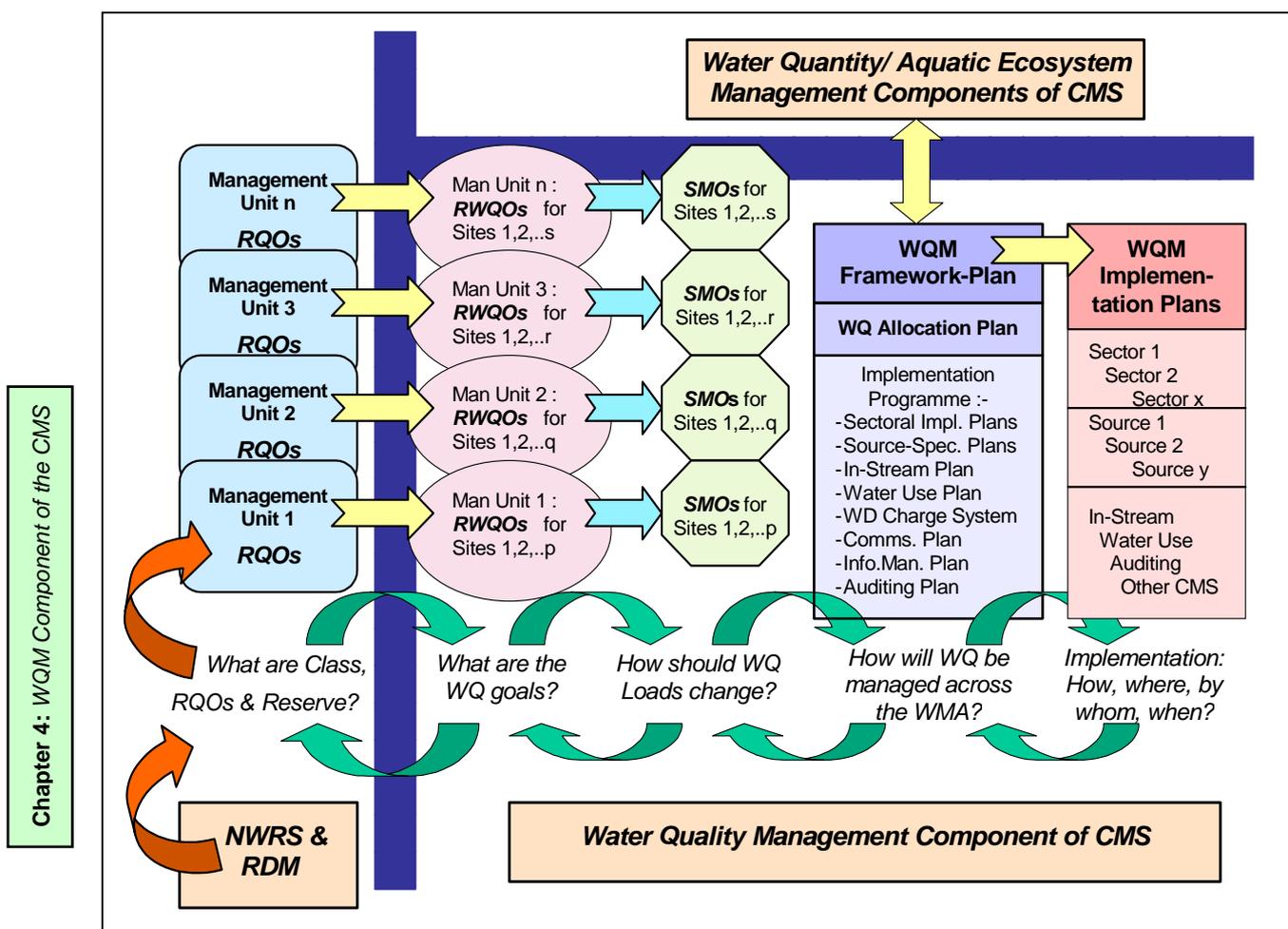


Figure 3: Conceptual Framework for Catchment Water Quality Management

The steps result in the following types of output, the details of which are provided in the *Guideline* document:

What are the goals for water quality management?

- *Resource Water Quality Objectives* reflect stakeholders' needs with respect to use of the water resources of the catchment. They include the objectives outlined in the NWRS and by RDM, but express stakeholders' needs over and above those outlined by these statutory measures. These objectives outline stakeholders' needs with respect to water quality, as well as their needs with respect to the disposal of water that contains waste to the resource. The process of determining these objectives is a consultative, consensus-seeking process, which may be incorporated into the process of developing RQOs, where the Classification and CMS processes are aligned.

How must water quality loads change to achieve the goals?

- *Source Management Objectives* provide the focus for the actions required to give effect to the *Resource Water Quality Objectives*. As such, they outline the changes in waste loads required to meet the immediate (5-year) Resource Water Quality Objectives.

Source Management Objectives are not source type- or sector-specific, but outline waste load targets on a catchment or sub-catchment basis. This is primarily a technical-scientific process, which iterates with the determination of the *Resource Water Quality Objectives*, and with the *Water Quality Management Framework-Plan*.

How will this be managed across the WMA?

- The *Water Quality Management Framework-Plan* outlines the arrangements for water quality management across the whole WMA, and as such represents the heart of the water quality management component of the CMS. It should specify the desired future water quality use load allocation per sector, the *strategic* approaches and plans for water quality management, the linkages to other components of the CMS important to water quality management, and the sectoral responsibility and programme for formulating and implementing Water Quality Management Implementation Plans required to meet the *Resource Water Quality Objectives*.

How, where, by whom and when will this be implemented?

- *Water Quality Management Implementation Plans* specify the management actions, responsibilities, resources and timeframes to mitigate or remediate the existing or future water quality impacts associated with priority sectors/ sources within a particular (sub-) catchment area, in order to give effect to the water quality use load allocation specified in the *Water Quality Management Framework-Plan*. A Plan may be sector- or issue-oriented, or even, sub-catchment/ Management Unit-focused, and may include statutory and/or non-statutory approaches that are more stringent than the general requirements for these sources.
- *Source-specific interventions* indicate the requirements (actions, resources and timeframes) for mitigating or remediating the water quality impacts from a specific source, under a water use authorisation, a cooperative agreement or a directive under the NWA, or under relevant sections of environmental statutes. They will generally be applied to specific concerns that have a significant impact on the water quality of a water resource, and may be linked to a *Water Quality Management Implementation Plan*.

These four stages provide a logical sequence to move from the objectives for IWRM throughout a WMA to the actions required at a localised level to achieve these objectives. The first three steps provide the basis for the WMA-wide water quality management component of the CMS, while the last step provides the basis for the local sub-catchment scale components of the CMS.

5 Water Quality Catchment Assessment Studies for Support to the Development of the WQM Component of a CMS

5.1 What is a Catchment Assessment Study (CAS)?

A CAS is undertaken to provide information on a catchment for use in IWRM. A CAS describes the water-related natural resources in a catchment, the human use of and impacts on those resources, the human needs regarding those resources and the socio-economic and institutional development of that catchment. But a CAS is more than merely an assembly of information. A CAS also identifies water-related stakeholders and elicits inputs and feed-backs from them regarding concerns, issues, problems and opportunities in the water resource field. A CAS, furthermore, prepares and implements predictive techniques that can be used to estimate the state of the water resources in a catchment for different future development scenarios.

5.2 Why Perform a Catchment Assessment Study?

A CAS enables the understanding, in water-related terms, of the natural catchment, of the way humans are changing it, and what the human and environmental needs are, so that sound and wise water resource management can ensue. A varied range of objectives may underlie a CAS:

- ❑ to provide an information/knowledge system suitable to *support and sustain development of a CMS* for a specific catchment, i.e. to enable the requirements of Section 9 of the NWA to be met
- ❑ to provide an information/knowledge system suitable to *support source-specific* management interventions
- ❑ to *inform the NWRS* in an iterative manner over time.

5.3 Variable Character of Catchment Assessment Studies

In order to be sound, the management of a catchment would have to be both *problem/issue-driven* (more local, more immediate) and *strategic* (more general, longer-term). These two-fold imperatives imply that any particular CAS, or some of its elements, may have the following variability in character:

- ❑ the boundaries of the CAS, or some of its elements, may vary from minor sub-catchments to full basins
- ❑ the spatial scale and temporal resolution of a CMS may vary from coarse to fine across the catchment in which an assessment needs to be undertaken; thus, the scale and resolution of such assessment tasks would need to reflect a similar variability
- ❑ the level of management focus may vary from an interest in broad trends and aggregated or averaged comparisons of resources, impacts and needs, to detailed analyses of underlying natural and developmental processes so that management strategies and action plans can be prioritised
- ❑ assessment tasks may be iterative - e.g. initially, a scoping exercise of existing understanding is undertaken, which then indicates where or which detailed assessments, including modelling, should follow; this, in turn, leads to further iterations according to the information/ knowledge requirements of the unfolding CMS establishment process.

5.4 The Links Between the WQM Components of the CMS and the CAS

The links between the WQM components of the CMS and the CAS can be unpacked in generic detail by considering the information/ knowledge requirements of the CMS according to the following steps:

- Formulate generic management-related “**Questions**” that arise during CMS development:
 - i.) *What is the water-related status of the study area and how did it get to this point?*
 - ii.) *Who are the water-related stakeholders and institutions in the study area and what are their respective jurisdictions, relationships, linkages and roles?*
 - iii.) *What are the study area’s water-related issues, concerns, problems and opportunities?*
 - iv.) *Where might the water-related status of the study area be heading in the future?*
 - v.) *What are the appropriate priority water-related management options?*
 - vi.) *Has catchment management achieved its objectives?*

- Formulate generic “**Tasks**” that would provide answers to the management-related Questions:
 - i.) *Characterisation of the current situation and historical trends.*
 - ii.) *Engagement of the water-related institutions and stakeholders in the CAS process.*
 - iii.) *Formulate and record water-related issues, concerns, problems and opportunities.*
 - iv.) *Projection of impacts of future water-related development scenarios on water resources.*
 - v.) *Formulate and prioritise catchment management options.*
 - vi.) *Monitor and audit the implementation of catchment management options.*

- Derive information/ knowledge “**Outputs**” that constitute the “answers” to the management-related Questions:
 - *A CAS can generically be partitioned into two distinct phases:*
 - Phase One: Describing and understanding the catchment***
 - Phase Two: Supporting catchment management decision-making***
 - *The respective Outputs, for the WQM component of the CAS, are listed in Table 1 below.*

TABLE 1: OUTPUT COMPONENTS OF A WATER QUALITY CATCHMENT ASSESSMENT STUDY

OUTPUT COMPONENT NO.	OUTPUT COMPONENT TITLE	PHASE NO.**
0	Inception summary of existing understanding, knowledge and past studies with regard to water quality in the catchment	One
1	Details of natural, developmental and administrative attributes and characteristics of the catchment relevant to water resources management	One
2	Requirements of resource-directed measures and the NWRS	One
3	Water use and conservation	One
4	Overview of adequacy of water availability	One & Two
5	User water quality requirements and constituents of concern	One & Two
6	Water quality of streamflow, reservoirs, estuaries, wetlands and groundwater	One
7	Point source waste discharges and source characteristics	One
8	Non-point source water quality loadings and impacts	One
9	Configured and calibrated water quality predictive tools / models	One & Two
10	Reconciliation: catchment sources and water quality patterns	One & Two
11	Status Reports on monitoring, physical data and characterisation information	One & Two
12	Stakeholder details and participation processes	One
13	Water-interest institutional arrangements and linkages	One & Two
14	Record of water quality issues and their origins	One & Two
15	Catchment management implications of water quality issues	One & Two
16	Vision (or long-term resource objectives) for water quality	One & Two
17	National and regional plans and projections of future water demands and catchment development	One & Two
18	Predicted future water quality at sites of management focus	Two
19	Management units and assessment spatial and temporal resolution	One & Two
20	Prioritised water quality management options	One & Two
21	Monitoring and auditing assessment	One & Two

** Phase One: *Describing and understanding the catchment*
Phase Two: *Supporting catchment management decision-making*

6 Conclusion

This document has provided a conceptual framework from which the formulation of the water quality component of a catchment management strategy, as well as a description of the information needs of the development process of that strategy, have been derived. It is only intended as a supporting resource information document, not as a guideline and nor is it meant to be an exhaustive exposition of the IWRM environment in South Africa. However, it raises certain issues that require further elaboration and debate as part of the on-going formulation and implementation of catchment management in South Africa.

This document's primary role is in support of its sister-documents, *A Guideline to the Water Quality Management Component of a Catchment Management Strategy* and *A Guide to Conduct Water Quality Catchment Assessment Studies* (see Document Index, page ii, of this Document). It should therefore be read as a conceptual orientation to the contents of both those documents.