

CAPE ACTION FOR PEOPLE AND THE ENVIRONMENT

**C.A.P.E. OLIFANTS-DOORN CATCHMENT
MANAGEMENT AGENCY PROJECT**

**Towards a Catchment Management Strategy
Water-Resource Protection Sub-strategy**

FINAL

MARCH 2009

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Project Details

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Relevance of Report

This documentation is of relevance to all persons whose mandate includes water-resource protection and freshwater biodiversity conservation.

Water-resource protection stakeholders/managers/decision makers:

The document serves as a guide to the integration of freshwater biodiversity conservation principles, policies and protocols and the Ecological Reserve into the Catchment Management Strategy, water-use decisions and institutional mandates for the Olifants-Doorn WMA.

It lists available water-resource protection and freshwater biodiversity conservation information for the Olifants-Doorn WMA, summarizes key findings and recommendations, lists relevant stakeholders and line-function managers, and provides available GIS data.

It can also be used to guide the development of resource protection sub-strategies of other WMAs.

Biodiversity conservation planners/ decision makers:

The document identifies areas with regards to biodiversity conservation planning that require additional input to allow for their inclusion in a CMS. It also highlights the importance of coordinated efforts between relevant mandated role players, including DWAF, DoA, SANBI and DEAT, in moving towards the development and effective implementation of the CMS and consequent protection of the freshwater resources in the Olifants-Doorn WMA.

Provincial and local authorities/conservation officials:

The document highlights areas of the CMS Water Resource Protection Sub-strategy that may overlap with your area of jurisdiction. As such, it can be used as a guide for water-resource protection and freshwater biodiversity conservation within your area of jurisdiction.

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- Annexure B: Summary of key findings and recommendations of relevance to water resource protection and freshwater biodiversity conservation in the Olifants-Doring catchment.
- Annexure C: Presentation from Workshop held on 6 February 2009.
- Annexure D: Database of relevant water management institutions, role players and line-function managers in terms of water resource protection and biodiversity conservation decision-making for the Olifants-Doorn WMA.
- Annexure E: Available GIS Data of the Olifants-Doorn WMA (CD).
- Annexure F: ISP Sub-areas, quaternary catchments and associated rivers for the Olifants-Doorn WMA, with map illustrating quaternary catchments.

Abbreviations and Acronyms

BGIS	Biodiversity Geographic Information System
C.A.P.E.	Cape Action for People and the Environment
CapeNature	Western Cape Nature Conservation Board
CCAW	Coordinating Committee for Agricultural Water
CMA	Catchment Management Agency
CFR	Cape Floristic Region
DEAT	Department of Environmental Affairs and Tourism
DoA	Department of Agriculture
DEA&DP	Department of Environmental Affairs and Development Planning
DWAF	Department of Water Affairs and Forestry
EC	Ecotatus Category
EISC	Ecological Importance and Sensitivity Category
EMC	Ecological Management Class
EWR	Environmental Water Requirements
GIS	Geographic Information System
ISP	Internal Strategic Perspective
IUA	Integrated Unit of Analysis
MC	Management Class
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NWA	National Water Act
PES	Present Ecological Status
RDM	Resource Directed Measures
RSA	Republic of South Africa
RQOs	Resource Quality Objectives
SANBI	South African National Biodiversity Institute
WfW	Working for Water
WMA	Water Management Area
WRC	Water Research Commission
WRCS	Water Resources Classification System

Definitions

Catchment Management Zone	A catchment management zone describes the entire upstream catchment of a critical management zone.
Critical Management Zones	Critical management zones describe those areas where management is essential for maintaining functionality of a focal area, and restrictions are likely to depend on the function of that zone. Use restrictions in critical management zones may only be temporal, for example, coinciding with seasonal spawning events.
Ecohydrology	Ecohydrology is a new integrative science that involves finding solutions to issues surrounding water, people, and the environment. One of the fundamental concepts involved in ecohydrology is that the timing and availability of freshwater is intimately linked to ecosystem processes, and the goods and services provided by fresh waters to societies. This means that emphasis is placed on the hydrological cycle and its effects on ecological processes and human well-being.
Reserve	The quantity and quality of water required (a) to satisfy basic human needs by securing a basic water of 25ℓ per person per day and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource as indicated in the National Water Act (Act No. 36 of 1998).
Environmental Water Requirements (EWR)	An allocation of water with a prescribed distribution in space and time, and of a specific quality, that is deliberately left in a river, or released into it, to manage river health and the integrity of ecosystems and communities sustained by river flows.
Freshwater Focal Areas	Freshwater focal areas” describe the location of a specific freshwater feature requiring protection, where management is likely to be fairly restrictive to prevent direct disturbances to the feature.
Olifants-Doorn Water Management Area (WMA)	The Olifants-Doorn WMA is one of nineteen WMAs in the country. It is located on the west coast of South Africa, extending from about 100 km to 450 km north of Cape Town. The major river in the WMA is the Olifants River, of which the Doring River (draining the Koue Bokkeveld and Doring areas) and the Sout River (draining the Knersvlakte) are the main tributaries. The WMA incorporates the E primary drainage region and components of the F and G drainage regions along the coastal plain, respectively north and south of the Olifants River estuary, covering a total area of 56 446 km ² .

Olifants-Doring Catchment	Refers to the specific drainage areas of the Olifants and Doring Rivers and their associated tributaries. This catchment refers to the E primary drainage region.
Passive compliance	The design or positioning of infrastructure in a manner that limits possible inappropriate use/abuse and that allows licence conditions, legal requirements and/or ecological requirements to be met as part of normal operations without the need for additional regular operational intervention oversight or compliance monitoring.
Pragmatic management	Recognising that we do not have perfect information about any natural system the implementation of resource protection measures should be done in a progressive manner over time, and should utilise available and/or inexpensive tools.
Preliminary Ecological Reserve	Determination of the Preliminary Ecological Reserve refers to Ecological Reserves signed off by the Minister in the absence of a classification system and Classification Process having been undertaken in a catchment. EWR assessments produce recommended Ecosystem Categories (EC) for significant water resources, which are used to define preliminary Ecological Management Class (EMC) of the resource and a Preliminary Ecological Reserve. The Director-General considers the socio-economic implications when making a decision on the Preliminary Reserve. 'Preliminary' does not refer to scientific confidence, and Reserves will not necessarily be re-determined for Classification, but the designated EMC (and therefore the volume of water allocated to the Ecological Reserve) may change. Preliminary determinations of the class and the Reserve are legally valid and enforceable by DWAF.
Resource Quality Objectives (RQOs)	A numerical or descriptive statement of the conditions that should be met in the receiving water resource, in order to ensure that the water resource is protected.
Sandveld Catchment	Refers to a coastal region included in the Olifants-Doorn WMA that comprises components of the G drainage regions, which are located south of the Olifants River estuary.

1 Introduction

1.1 *Project background*

1.1.1 **Background to the C.A.P.E. programme and projects**

Cape Action for People and the Environment (C.A.P.E) is a partnership programme, hosted by the South African National Biodiversity Institute (SANBI), which seeks to conserve and restore the biodiversity of the Cape Floristic Region (CFR) and adjacent marine environment, while delivering significant benefits to the people of the region. The Ecological Reserve Implementation (ERI) project, led by CapeNature in partnership with the Department of Water Affairs and Forestry (DWAF)¹, is part of C.A.P.E.'s Biodiversity Conservation and Sustainable Development (BCSD) project, which is funded by the Global Environment Facility through the World Bank.

C.A.P.E identified the implementation of the Ecological Reserve and freshwater biodiversity protection requirements in the Cape Floristic Region (CFR) as a priority to conserve biodiversity in the CFR. In accordance with this, C.A.P.E initiated several projects aimed at promoting the implementation of the Ecological Reserve and inclusion of freshwater biodiversity conservation considerations in catchment management and water-use decision-making.

The establishment of Water Management Areas (WMAs) and Catchment Management Agencies (CMAs) in South Africa has already been initiated and it is likely that appointment of the Governing Boards of the CMAs in the CFR will be completed with the next three years. These include the Breede, Berg, Olifants-Doorn, Gouritz and Fish-to-Tsitsikamma WMAs, although the number of CMAs may be fewer. For instance, there is a possibility that Olifants-Doorn and Berg WMAs will be governed by a single CMA.

The compilation of Catchment Management Strategies (CMS) will be one of the first responsibilities of the newly created CMAs.

This project focused on the Olifants-Doorn WMA, and aimed to:

- Develop a water-resource protection sub-strategy for the CMS for the Olifants-Doorn WMA to demonstrate the integration of biodiversity protection measures and other sustainability principles, and to provide a blueprint that can be followed in other CMSs in the CFR.

¹ **Please note:** Changes occurred in the composition and structure of government departments after the May 2009 elections. The functions of Water Affairs and Environment Affairs joined as the Department of Water and Environmental Affairs (DWEA) whilst Forestry moved to the Department of Agriculture, Fisheries and Forestry. This report however still refers to the Departments as they were at the end of March 2009, i.e. Department of Water Affairs and Forestry (DWAF) and Department of Environment and Tourism (DEAT).

- Discuss the implications of biodiversity protection measures and other sustainability principles for the institutional processes that support the management of the Olifants-Doorn WMA.

1.1.2 Relevant information available for the Olifants-Doorn WMA area

The Olifants-Doorn WMA (Figure 1.1²) was selected as a case study because there is a wealth of water-resource protection, freshwater biodiversity and conservation planning information for the Olifants-Doorn WMA. This is thanks to concerned investments by DWAF and Department of Environment and Tourism (DEAT) in studies that generated the required information, including:

- The Olifants/Doring River Comprehensive Reserve determination study (2006; funded by DWAF);
- The Sandveld Groundwater Reserve determination studies (2000; funded by DWAF);
- Ongoing River Health surveys and the State of the Olifants/Doring River Report (2006; funded by DWAF);
- The development of the Water Resource Classification System, for which the Olifants/Doring Catchment was used as a “proof-of-concept” catchment (2006; funded by DWAF);
- Freshwater biodiversity conservation plan for the Olifants-Doorn WMA (2006; funded by DWAF);
- Jan Dissels River Compulsory Licensing (2008; funded by DWAF);
- The establishment of Water User Associations (WUAs);
- The establishment of the Catchment Management Reference Group in preparation of the establishment of the CMA (2003);
- The development of a proposal for the establishment of the Olifants-Doorn CMA (2005; funded by DWAF); and
- The Olifants/Doorn WMA: Olifants/Doorn Internal Strategic Perspective (ISP) (2005; funded by DWAF).

There have also been a number of other important initiatives relating to the protection of biodiversity of the Olifants-Doorn WMA, including:

- Proclamation of Greater Cederberg Biodiversity Corridor;
- Fine-scale planning of portions of the Olifants-Doorn WMA (2008; funded by SANBI-C.A.P.E.);

² An enlargement of Figure 1.1 and a table listing the quaternary catchments and associated rivers are included in Annexure F.

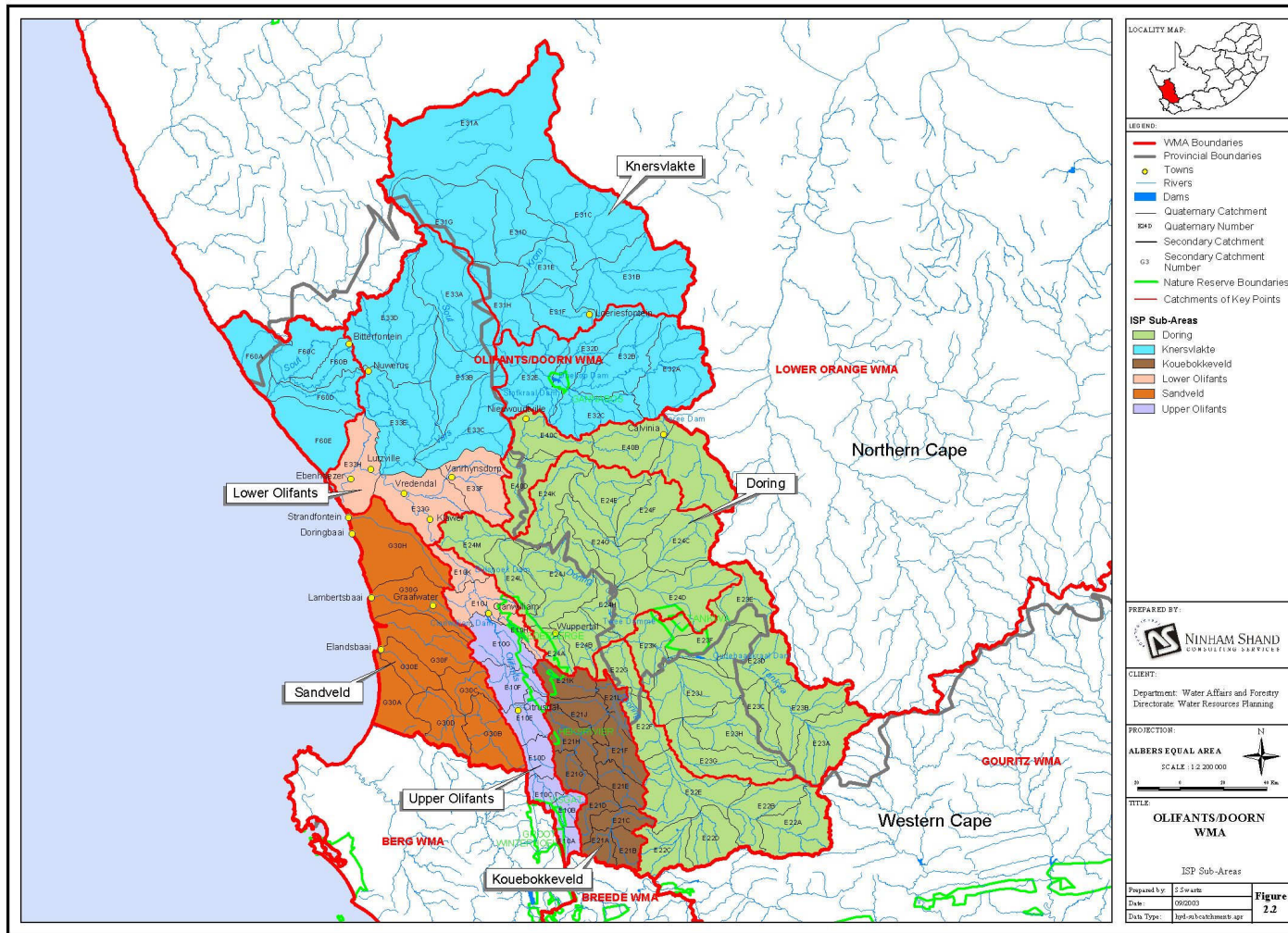


Figure 1.1 The Olifants-Doorn WMA

- The Olifants-Doorn Water User Association (WUA) capacity building project (2005/2006; initiated by WWF);
- The Ecological Reserve Implementation Project which focused on the Olifants-Doring (2008, in conjunction with CAPE); and
- Development of a Estuary Management Plan for the Olifants-Doring Estuary (2008; funded by DEAT).

In addition, the DWAF Internal Strategic Perspective (ISP) for the Olifants-Doorn WMA was compiled in 2005, which presented the DWAF's proposals for management of the water resources within the WMA leading up to the establishment of a fully-operational CMA and the development of a CMS (Table 1.1). Given the number of studies that have been completed since the development of the ISP (see list above), the information in the ISP probably needs updating.

Table 1.1 ISP sub-areas and catchments

ISP Sub-area	Catchments
Upper Olifants	E10A to E10G
Koue Bokkeveld	E21A to E21L
Doorn	E22, E23, E24A-M, E40A-D
Knersvlakte	E31A-H, E32, E33A-F, F60
Lower Olifants	E10H-K, E33F-E33H
Sandveld	G30A (part) to G30H

A number of resource protection and other related IWRM studies have been undertaken since the development of the ISP, accordingly there is a need to identify changes required to update the information in the ISP relating to freshwater biodiversity and terrestrial biodiversity conservation, based on new studies completed subsequent to the compilation of the ISP.

1.1.3 C.A.P.E. Olifants-Doorn CMA Project

This project aims to promote the integration of freshwater sustainability and biodiversity protection principles, policies and protocols, and the Ecological Reserves to support these, into the Catchment Management Strategy (CMS), water-use decisions and institutional mandates for the Olifants-Doorn WMA.

The Terms of Reference for the study were as follows:

- Task 1: Collate all available water-resource protection and freshwater biodiversity information pertaining to the Olifants-Doorn WMA into a single document that will inform the CMS and the Internal Strategic Perspective (ISP).
- Task 2: Identify institutions, and public and government stakeholders for input into an updated ISP, and compile a framework for a CMS Water-resource Protection Sub-strategy for the Olifants-Doorn WMA.

Note: The Water Resource Protection Sub-strategy of the CMS is one of approximately ten sub-strategies that will need to be developed for the CMS. DWAF guidelines for developing CMSs (DWAF, 2007) suggest that a sub-strategy should identify: key strategic areas to be reflected in the CMS; information needs; priorities and gaps; and resources and skills needed. It should also consider cooperative governance.

In October 2008, CapeNature appointed Ninham Shand, in association with Southern Waters Ecological Research and Consulting cc and Geohydrological & Spatial Solutions International (Pty) Ltd (GEOSS), to undertake the study.

1.1.3.1 Task 1: Overview of existing information

Task 1 was to review and summarise all the relevant and available water-resource protection and freshwater biodiversity information for the Olifants-Doorn WMA.

The approach adopted was:

- The project team identified the relevant studies and initiatives. Refer to **Annexure A**.
- The project team reviewed and summarised the key findings of these studies and initiatives, and compiled a document that provides a summary of the key findings and their relevance to water resource protection and freshwater biodiversity conservation in the Olifants-Doorn WMA. Refer to **Annexure B**.
- The project team and Olifants-Doorn water and biodiversity managers met at a one-day workshop to consider the requirements for the CMS Water Resource Protection Sub-strategy. The workshop also assisted in determining the CMS sub-strategy roles and information needs of the various catchment managers, and defined the process used to compile the CMS Water Resource Protection Sub-strategy (Task 2). Refer to **Annexure C** for a copy of the workshop participants and presentations.

1.1.3.2 Task 2: Compile a framework for the CMS Water Resource Protection Sub-strategy and prepare input for the updated ISP of the Olifants-Doorn WMA

Task 2 had two related outputs:

1. A list of institutions and their mandates in terms of water resource protection and biodiversity conservation decision-making in the Olifants-Doorn WMA.

2. The CMS water resource protection sub-strategy framework (this report).

The approach adopted was:

- The relevant CMA water management institutions (including, but not limited to, the Reference Group, Advisory Committee, WUAs and Water Forums) and other key stakeholders were identified and contacted (via written correspondence) to update their details and/or provide information on other institutions or stakeholders of relevance to the project.
- The line managers in national and regional DWAF, DEAT, Provincial D:EA&DP, CapeNature, DoA, and district and local authorities that contribute towards decision-making about the management and use of water resources were identified, and their titles and contact details documented.
- Other nature conservation non-government organizations (NGOs) and private conservation initiatives were identified and contacted either by telephone or written correspondence, and the title and contract details of their representatives were documented.
- A framework for the CMS Water Resource Protection Sub-strategy was developed. The extent to which the DWAF (2007) recommendations for CMSs were considered is outlined in Table 1.2.
- Existing GIS coverages for the Olifants-Doorn WMA were collated. No new covers were prepared. Existing coverages were reviewed and gaps were identified.

The database listing all institutions and their respective mandates in terms of water resource protection and biodiversity conservation decision-making is provided in **Annexure D**. The GIS data is included in **Annexure E** (electronic format only).

No new technical work was undertaken for this study. The study used existing information to provide guidance on:

- The technical work needed to compile a management plan to fulfill the CMS Water Resource Protection Sub-strategy; and
- Existing measures to which the CMP should comply.

This report should be a 'working document', and will require revision and adjustment and new information and new insights become available.

Table 1.2 Water Resource Protection Sub-Strategy Checklist

Water Resource Protection sub-strategy requirement:	Where it is addressed in this report?
a) Identify key strategic areas to be reflected in the CMS	
<ul style="list-style-type: none"> Strategic actions required to achieve RDM for the WMA, including protocols for stakeholder participation 	Section 2 (see sub-sections on ‘data requirements and activities’)
<ul style="list-style-type: none"> Strategic actions in cases where there are no RDM or they are incomplete 	Section 2 (see sub-sections on ‘data requirements and activities’)
<ul style="list-style-type: none"> A clear water resources monitoring and enforcement programme 	Section 9
<ul style="list-style-type: none"> A strategy for establishing and building partnerships to meet the objectives of water resources protection in the WMA, including international conventions 	Preliminary inputs Section 4 and Section 3.1.1
<ul style="list-style-type: none"> Each strategic action should address time frames, responsibility, budgets 	Table 1.4 and Section 1.4 (i.e. activities for next five years are outlined in Sections 2–5, activities beyond this are outlined in Sections 6–9), Roles and responsibilities outlined in Section 3.2 and Table 3.2, No budgets have been stipulated.
<ul style="list-style-type: none"> Linkages between various planning instruments 	Not addressed
<ul style="list-style-type: none"> Education and awareness instruments 	Section 4
b) Identify information needs	
<ul style="list-style-type: none"> Status of water resources (PES of rivers, groundwater, estuaries, wetlands) 	Section 2
<ul style="list-style-type: none"> Status of RDM in the WMA including status of compliance 	Status of compliance not specifically addressed.
<ul style="list-style-type: none"> International sites ratified by convention (e.g. RAMSAR) and related agreements Is the water resource afforded protection e.g. conservancies or protected areas? 	Section 2.2.1
<ul style="list-style-type: none"> Other water resources protection initiatives operative in the WMA, including other conservation/ environmental plans 	Refer to Annexures A and D
<ul style="list-style-type: none"> Spatial distribution, land tenure and governance arrangements for water resources within the WMA (includes inventory of wetlands and estuaries) 	Annexure E

Water Resource Protection sub-strategy requirement:	Where it is addressed in this report?
c) Address priorities and gaps	
<ul style="list-style-type: none"> Operative plans (where appropriate e.g. operating rules for dams to give effect to reserve and other protection requirements) 	Priorities are the activities to be undertaken within next five years (refer to Table 1.4 and Sections 2 – 5). Where gaps have been identified, data requirements and activities are recommended in Sections 2- 9
d) Identify resource needs	
<ul style="list-style-type: none"> Capacity building 	Section 4
<ul style="list-style-type: none"> Human resources – how they will be accessed and shared 	Not addressed.
e) Identify skills needed	
<ul style="list-style-type: none"> Adaptive management, use of objectives hierarchies, knowledge of Reserve determination process, knowledge of freshwater biodiversity conservation planning 	Not addressed.
<ul style="list-style-type: none"> Dam operators to give effect to Reserve, calculation of water balances, auditing e.g. of mines 	Section 8.1.2
f) Specifically	
<ul style="list-style-type: none"> Does the sub-strategy consider issues of co-operative governance and institutional arrangements? 	Section 3.1.1
<ul style="list-style-type: none"> Are the following potential partnerships considered? DEAT, Working for Water, Working for Wetlands, etc. 	Preliminary comments in Section 4.
<ul style="list-style-type: none"> Are regulatory requirements considered? 	Sections 3.1 and throughout document, where applicable e.g. Section 7.1

1.2 *Project team*

The members of the project team, and their assigned tasks, are listed in Table 1.3.

Table 1.3 Project team

Name	Firm	Tasks
Mr E Van der Berg	Ninham Shand	Project Director
Ms K Shippey		Project Manager
Ms N Holland		Research, literature review, liaison with role players, report writing
Dr C Brown	Southern Waters	Development of sub-strategy; report writing
Mr R Magoba		Review of studies, initiatives relating to freshwater biodiversity conservation and the Reserve determination; report writing
Dr A Joubert		Review of studies, initiatives relating to freshwater biodiversity conservation; development of sub-strategy; report writing
Mr J Conrad	GEOSS	Review of studies, initiatives relating to groundwater; GIS, development of sub-strategy; report writing

Ms Jeanne Nel, CSIR, contributed towards the section on biodiversity planning initiatives (Section 2.3).

Mr Dana Grobler provided valuable insight and review in this role as the C.A.P.E Ecological Reserve Implementation Project Manager.

1.3 *Principles informing a Water-Resource Protection Sub-strategy*

A Water-Resource Protection Sub-strategy should be informed and guided by the principles of progressive implementation, pragmatic compliance and promotion of the interests of resource protection in all aspects of water-resource management. The CMS is not limited to the mandate of DWAF and therefore should incorporate elements of the resource protection that are the responsibility of other institutions e.g. Freshwater biodiversity planning and Conservation a DEAT responsibility.

Principle 1: Progressive implementation

Implementation of resource protection measures should be done in a progressive manner over time. Experience from the world over has shown that implementation of resource

protection measures cannot be achieved all at once or in a short time, and that progressive implementation yields the best results.

Principle 2: Pragmatic compliance:

Pragmatic management and monitoring measures should be adopted wherever possible. As part of this passive compliance arrangements should be identified and implemented wherever possible. These include:

- Maintenance of a set of free-flowing rivers, from the source to the sea, that can provide the seasonality and variability of flow patterns required to maintain ecosystems, facilitate movement of migrating animals and provide refuge and restocking areas for plants and animals.
- Release pipes in farm dams to ensure that the low flow requirements of the Reserve are provided automatically.
- Designated riparian buffers that represent no-go areas for development and/or abstraction.
- Simple operating rules of the major dams in the catchment.
- Demarcations on bridges and other in- or near-channel structure that can be used to assess whether or not the required environmental flows are being met.

Principle 3: Promote the interests of resource protection in all aspects of water-resource management:

Ensure that the interests of water-resource protection are being met in other areas of water-resource management, as these will ultimately affect the success or failure of water resource protection. An example of this includes incorporation of a buffer zone alongside rivers, stream and around wetlands to, *inter alia*, promote recharge of the alluvial aquifers, provide protection from non-pollution from the surrounding catchment, corridors for animal movement and to stabilize banks thereby reducing erosion. This is in line with a global move to embrace the principles of ecohydrology, which, among other things, recognises that, the timing and availability of freshwater is intimately linked to ecosystem processes. Other examples of the promote the interests of resource protection in all aspects of water-resource management include aligning with other sub-strategies to ensure that activities undertaken and or equipment procured can fulfill multiple needs wherever possible, for instance, equipment needed for increased accuracy of hydrological monitoring, modeling and yield analysis, if selected carefully, may also contribute towards water-resource protection compliance monitoring thereby fulfilling multiple functions.

1.3.1 Approach to compiling the CMS Water Resource Protection Sub-strategy

The first of these principles, progressive implementation, has informed the approach to compiling the CMS Water Resource Protection Sub-strategy. To this end, the activities

required to realise full implementation of resource protection measures have been divided into those that could conceivably be accomplished over the next two to five years (Table 1.4), and those that are reliant on the first set, and thus will only be accomplished once they have been completed. The activities envisage for the next five years encompass mainly those related to integration of various planning initiatives, initiation of public consultation and finalisation of the future plans for the aquatic resources in the catchment in terms of both socio-economic and resource-protection goals. The post-five-year activities are mainly those related to designation of protected and semi-protected areas, implementation of the Reserve requirements for the rivers, wetlands and estuary, and monitoring progress.

Table 1.4 2009-2014 Time line for activities identified for the next five years

Task	Activities	Time frame
Finalise integrated planning for freshwater resources	Disaggregate hydrology for tributaries within WMA needing Reserve	3 months
	Undertake desktop Reserve determination for tributaries	2 months
	Finalise biodiversity planning for the catchments and integration of biodiversity targets into the EWR determinations, and planning initiatives through co-ordination between DWAF Reserve information and SANBI biodiversity mapping and fine scale planning	3 months
	Determine of Environmental Water Requirements (EWRs) for all significant water resources (NWA 1998), much of which have already been completed	3 months
	Undertake Classification process on River and Estuary only, demarcate wetland and groundwater buffer zones	1 year
Define of the Resource Quality Objectives for significant aquatic resources based on outcome of Classification	Section 2.6	3 months
Determine the institutional arrangements, roles and responsibilities as they pertain to water resource management and protection in the WMA	Liaise with government departments, NGOs and community organizations to ensure that the institutional arrangement for resource protection are well understood and avoids duplication. Ensure the interfaces are agreed upon, well documented and well understood.	2 years
Secure adequate long-term funding	Establish appropriate financial arrangements to support the management aquatic ecosystems within the WMA	1 year

The second principle, pragmatic compliance, should increasingly inform the procedures and structures put in place to manage and monitor the Reserve. It is likely that funds to manage and protect water resources will remain limited (refer to Section 5) and keeping it simple will greatly enhance the chances of success.

The third principle, promotion of the interests of resource protection in all aspects of water-resource management, underlies all aspects of the sub-strategy, in particular ensuring protection concerns are adequately considered in other sub-strategies, and those pertaining to cooperative governance.

1.4 *Layout of this report*

The report is ordered according to the activities identified for the next five years. Activities that would occur thereafter, are also addressed but at a lower level of detail, as they will be informed by the first set of activities. To this end:

Section 1: (this chapter) provides a brief background to the project, the project team and the approach used, and presents set of principles used to guide the development of the Resource Protection Sub-strategy.

ACTIVITIES FOR THE NEXT FIVE YEARS

Section 2: Outlines the rationale behind and activities needed to finalise the integrated planning for aquatic resources in the WMA. These activities form part of the activities for the next five years.

Section 3: Highlights the importance of cooperative governance with respect to water resource management and protection, and recommends a set of activities for achieving this in the WMA in the next five years.

Section 4: ‘A person is a person through other persons’. This section deals with the need for increasing the awareness of the need for an integrated sustainable approach to water resource management in the WMA, and the opportunities for cooperation that will need to be realized if Integrated Water Resource Management (IWRM) is to succeed (not yet compiled).

Section 5: Addresses the need to establish appropriate financial arrangements to support the management aquatic ecosystems within the WMA.

POST-FIVE-YEAR ACTIVITIES

Section 6: Outlines resource protection concerns and recommendations with respect to water use in the catchment.

Section 7: Non-flow related water resource protection interventions.

Section 8: Implementation and protection infrastructure.

Section 9: Monitoring data storage and reporting.

2 Finalise integrated planning for aquatic resources

Resource protection in the Olifants-Doorn WMA would be greatly assisted by integrating and finalising the plans for the major parts of the area, as this would allow, *inter alia*, funds to be reallocated from planning initiatives to implementation and management.

Of particular concern with respect to planning are the future water use and the formalisation of the Ecological Reserve for the aquatic ecosystems in the catchment. From a resource protection perspective the most important activities required to achieve this are:

- The determination of Environmental Water Requirements (EWRs) for all significant water resources (NWA 1998), much of which have already been completed (Sections 2.1 and 2.2).
- Finalisation of freshwater biodiversity planning for the catchments and integration of biodiversity targets into the EWR determinations, and planning initiatives (Section 2.3).
- Implementation of a Classification Process for the Olifants-Doorn WMA (Section 2.5).
- Definition of the Resource Quality Objectives for significant aquatic resources in the Olifants-Doorn WMA (Section 2.6).

2.1 Environmental Water Requirements – Olifants-Doorn WMA

2.1.1 Rivers

A Comprehensive Reserve determination for six sites on the Olifants-Doring Rivers, commissioned by the RDM Chief Directorate, DWAF, was completed in 2006, and resulted in EWRs for a range of possible future conditions for the six sites. The Comprehensive data were used to extrapolate EWRs to 46 nodes throughout the catchment (Figure 2.1) as part of the proof of concept activities for the development of the Water Resource Classification System (WRCS). Cumulative EWRs for B, C and D ecological conditions were determined for each of these nodes. In addition, incremental EWRs for B, C and D condition were determined for the river reaches represented by each node. A Comprehensive Reserve Determination was also undertaken for the estuary, the results of which were included in the development of the WRCS. The Minister, represented by the delegated authority DWAF signed off a configuration of cumulative and incremental EWRs as a configuration of Preliminary Reserves for the rivers and estuary in July 2008 (see Table 2.1). These will be used to guide DWAF management and licence applications until such time as the Classification Process has been completed and the Reserve configurations can be finalized.

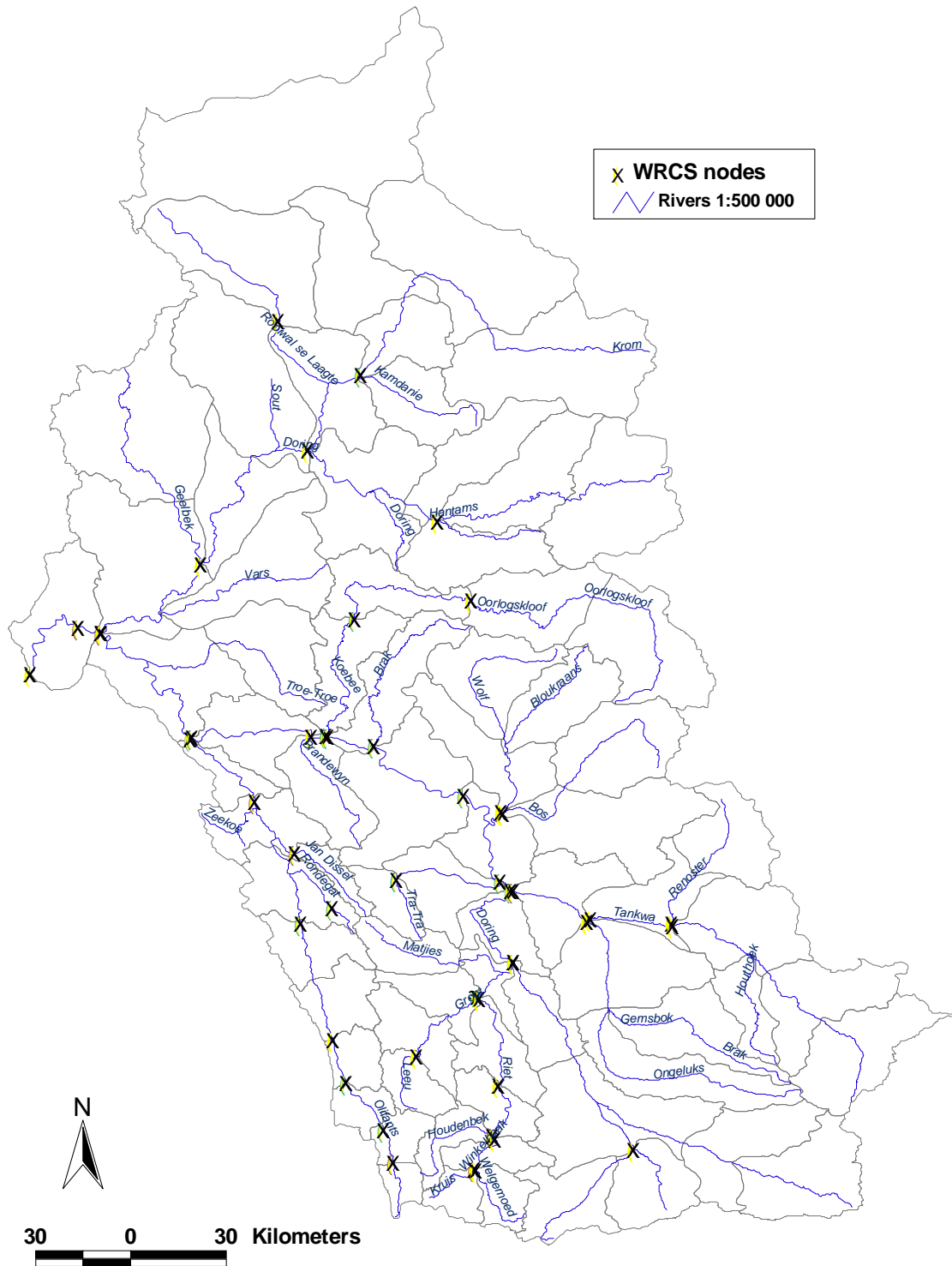


Figure 2.1 The Olifants-Doring catchment showing the 47 nodes for which EWRs were determined by extrapolation from six sites (red triangles) as part of the development of the WRCS using the Olifants-Doring as a proof-of-concept catchment.

Table 2.1 Nodes and rivers in the Olifants-Doring catchment for which EWRs have been determined. The Preliminary Reserve Ecological Category (EC) signed off in July 2008, the Present Ecological State (PES) and Ecological Importance and Sensitivity Category (EISC) are also given. Hydrological information is available cumulatively and incrementally for each node / catchment included. The rows are shaded where the catchment(s) given in the Reserve documentation could not be reconciled to a node. Comments are included where relevant.

Quaternary ³	River	Ecological Category	Ecological reserve (% MAR)	BHN Reserve (% MAR)	Total Reserve (%MAR)	nMAR (MCM)	Node	PES	EISC	Comments
E10A	Olifants	D	13.58	0.02	13.6	61.373	R47	C	H	
E10B	Olifants	B	21.24	0	21.24	131.157	R44	C	H	
E10C	Olifants	B	39.48	0.01	39.49	180.907	R42	B	VH	
E10D	Olifants	C	13.56	0.01	13.57	229.932	R40	C	M	
EWR 1 (E10F)	Olifants	D	26.6	0.01	26.61	331.551	R33	D	M	
EWR3	Rondegat	B	43.47	0.14	39.62	7.45	R34	B	M	
E10G / E10H	Olifants	C	21.25	0.14	21.39	33.507				Possibly inflow into Clanwilliam Dam, i.e., river reach from EWR1 to the dam
E10G & H Scaled	Jan Dissels	D	14.9	0.14	15.04	46.205	R24	D	M	Possible that E10G is misnamed and should be E10J
E10J	Olifants	D	13.69	0	13.69	467.349	R23	D	M	
E10K	Olifants	E	9.31	0	9.31	519.676	R13	E-F	M	
E21A	Kruis	D	12.47	0	12.47	34.884	R48	E-F	L	
E21B	Welgemoed	C	19.36	0	19.36	26.936	R49	E-F	L	
E21C	Winkelhaak	C	19.35	0.02	19.37	86.75	R46	E-F	L	
E21D	Houdenbeks	D	12.47	0	12.47	45.369	R45	E-F	L	
E21E	Riet	C	19.42	0	19.42	151.708	R43	B	L	
E21F	Riet	C	21.24	0.01	21.25	168.254	R39	B	L	
E21G	Leeu	C	20.35	0.01	20.36	30.561	R41	B	L	
EWR 6 (E21J)	Groot	B/C	43.76	0.02	43.78	137.858	R38	B	L	
E21K / E21L	Maatjies	C	19.79	0.01	19.8	278.509	R37	B	L	
E22C / E22D	top of Doring, no name tributary	C	17.76	0	17.76	17.323	R50	C	L	
E22A / E22B / E22E / E22F	Doring	B	26.38	0.04	26.42	39.642	R36	B	L	
E22G	Doring	B	45.6	0	45.6	319.264	R28	B	VH	
E23A / E23B / E23C / E23D	Tankwa	C	17.58	0.1	17.59	20.083	R32	C	L	
E23E	Renoster	C	17.64	0.23	17.87	6.6				Was mislabelled Tankwa
E23F	Tankwa	C	17.6	0.05	17.65	27.201	R31	C	L	

³ Refer to Annexure F for a list of the ISP sub-areas, quaternary catchments and associated rivers.

Quaternary ³	River	Ecological Category	Ecological reserve (% MAR)	BHN Reserve (% MAR)	Total Reserve (%MAR)	nMAR (MCM)	Node	PES	EISC	Comments
							And R29	C	L	
E23G / E23H / E23J	Ongeluks	C	17.56	0.04	17.6	35.171	R30	C	L	
E23K	Tankwa	D	12.18	0	12.18	319.793	R27	C	L	
E24A	Tra-tra	B	26.91	0.12	27.03	17.31	R25	B	L	
E24B	Tra-tra	B	26.82	0.05	26.87	27.583	R26	B	L	
E24C / E24D	Bos	C	17.69	0.1	17.7	15.922	R21	C	L	
E24E / E24F / E24G	Wolf	C	17.69	0.2	17.71	13.793	R22	C	L	
E24H (EWR 4)	Doring	B	45.6	0	45.6	421.47	R20	B	H	
E24J	Doring	B	45.6	0	45.6	401.44	R19	B	H	
E24K (EWR 5)	Doring	B	45.6	0	45.6	509.621	R16	C	H	
E24L	Brandewyn	C	19.74	0	19.74	462.055	R15	C	H	
E24M	Doring	B	45.6	0	45.6	471.872	R14	C	H	
E31B / E31C / E31D / E31E	Kromme	B	26.12	0.5	26.17	3.091	R2	C	M	
E31G	Rooiwalse Laagte	C	17.3	2.2	19.5	0.681	R1	C	M	
E32A / E32B / E32C	Hantams	C	17.86	0.2	17.88	8.576	R4	C	M	
E31F / E31H / E32E	Kamdanie/ Krom/ Hantams	C	17.85	0.12	17.97	12.351	R3	C	M	
E33A / E33B	Sout	C	17.69	0.1	17.7	19.218	R5	C	M	
E33C / E33D / E33E	Sout	C	18.22	0.03	18.25	22.265	R8	C	M	
E33F / E33G	Hol ?? Troe-troe→Olifants	D	12.52	0.01	12.53	949.76	R9	D	M	
E33H	Olifants	D	13.4	0.01	13.41	972.643	R7	D	M	
E40A / E40B	Oorlogskloof	C	17.73	0.55	18.28	13.354	R12	C	M	
E40C	Oorlogskloof /Koebee	B	26.68	0.06	26.74	20.117	R11	B	H	
E40D	Oorlogskloof /Koebee	B	26.74	0.06	26.8	27.071	R17	C	H	
Estuary	Olifants	C	56	0.01	56.01	1055	E	C	VH	

The incremental EWRs represent the combined EWRs for the tributaries that join the river reach represented by each node. In some cases, there may be only one tributary, in which case the incremental EWRs represent those for that tributary, but in other cases the incremental EWRs represent the combined EWRs for between two and eight tributaries. Disaggregation of the EWRs for reaches where there is more than one tributary requires

hydrological data at a finer scale than was available for the WRCS development project. It will also require finer scale Present Ecological Status (PES) and Ecological Importance and Sensitivity (EIS) assessments than are currently available.

Tributaries play a major role in freshwater biodiversity conservation, and are selected as target areas for conservation by SANBI and DEAT (see Section 2.3). This means that the disaggregation of the hydrology and the finer-scale assessment of PES and EIS is a high priority for the inclusion of biodiversity targets in the Classification Process. More on this in Section 2.3.

Legal status: The Minister, represented by the delegated authority DWAF signed off a configuration of cumulative and incremental EWRs as a configuration of Preliminary Reserves for the rivers and estuary in July 2008.

2.1.1.1 *Data requirements and activities*

In order to include the tributaries in the integrated planning of the Olifants-Doorn WMA, the following data and activities are required:

1. *Monthly naturalised hydrological sequences for the tributaries identified in Table 2.8, and any other key tributaries identified as important for inclusion in Classification (see Section 2.3).*
2. *Field-based assessments of PES and EIS for the tributaries identified in Table 2.8.*
3. *Extrapolation EWR determinations for the tributaries identified in Table 2.8.*

2.1.2 **Wetlands**

The wetlands of the Olifants-Doring Catchment were not included in the proof of catchment determinations done for the Water Resources Classification System. The reason for this was that no EWR determinations have been undertaken for these systems. These would need to be completed before they could be incorporated into a Classification Process for the Olifants-Doring Catchment.

Legal status: None

2.1.2.1 *Data requirements and activities*

In order to include the wetlands of the Olifants-Doring catchment into the integrated planning in the Olifants-Doorn WMA, the following data and activities are required:

- Implement a baseline-monitoring programme to collect required information for a wetland EWR study;
- Create a wetland inventory for the catchment and prioritise wetlands for protection and/ or rehabilitation;

- Undertaken EWR studies for wetlands prioritised for protection and/or rehabilitation; and
- Set buffers for wetlands as a passive compliance mechanism.

2.1.3 Estuary

A Comprehensive Reserve determination for the Olifants Estuary, commissioned by the RDM Chief Directorate, DWAF, was completed in 2006.

Legal status: The Minister, represented by the delegated authority DWAF, signed off a configuration of cumulative and incremental Preliminary Reserves for the rivers and estuary in July 2008.

2.1.3.1 Data requirements and activities

None.

2.1.4 Groundwater

Parsons and Associates (2000) completed a rapid Reserve determination for groundwater in the Olifants-Doring Catchment. Thereafter GEOSS (2003) developed the Terms of Reference for more comprehensive Groundwater Reserve determinations for the Olifants-Doring Catchment, which were addressed by SRK in 2006. Based on the importance, sensitivity and demand for groundwater, various levels of determinations were undertaken (SRK 2006): medium confidence Reserve determinations were done for catchments E21A – K; E22C, D; E24M; E3E – H and E40A and B; and low confidence determinations were done for most of the remaining catchments. Quaternary catchments G30, F60 and E10 were excluded from the SRK study as the G30 catchments were later addressed at the high confidence level in a separate study (Conrad, 2006), and Parsons and Associates determined the Reserve for the E10 catchments in a project funded by the Water Research Commission (Flanagan *et al.*, 2006). Budget constraints precluded the F60 catchments from being studied as well.

Legal status: The groundwater Reserves for the Sandveld (G30B-G30G) have been signed off. The Reserves for the Olifants – Doorn WMA have not yet been approved by DWA.

2.1.4.1 Data requirements and activities

The groundwater Reserves should be collated into a single document and database, with the relevant levels of confidence attached. The reason for the omission of the F60 catchments should also be highlighted.

2.2 Environmental Water Requirements – Sandveld

2.2.1 Rivers and wetlands

The Sandveld comprises mainly of three parallel river systems of varying length, catchment area and hydrology, of these the seasonal Langvlei, Jakkals and Verlorenvlei are the most significant.

These systems exist as a series of wetlands, connected by surface channels in places, but mostly by subsurface flow. All of the systems are largely groundwater dependent. Thus implementation of the Ecological Reserves for these systems will place restrictions on the volume of groundwater that can be used.

Only streams within the catchments G30B and C experiencing flow throughout the year. The remaining catchments experience no flow for more than 33% of the year.

Table 2.2 Area and mean annual runoff (MAR) for the quaternary catchments (WR90 hydrological data).

Quaternary Catchment	River	Area (km ²)	MAR (MCM)
G30A	-	761	4.8
G30B	Kruismans River	658	18.9
G30C	Bergvallei River	351	11.3
G30D	Krom Antonies River	534	11.9
G30E	Verlorenvlei River	352	1.9
G30F	Langvlei River	780	6.8
G30G	Jakkals River	314	1.7
G30H		1077	3.3

Ecological Reserve (Rapid Level II) specifications exist for (Table 2.3):

Langvlei River (G30F):

- (i) EWR for the lowest reach;
- (ii) EWR for the Wadrif Wetland; and
- (iii) EWR for the Wadrif Pan.

Jakkals River (G30G):

- (i) EWR for the lowest reach; and
- (ii) EWR for the Jakkalsvlei Pan.

Table 2.3 Surface water EWRs

Ecosystem	Location	PES	EISC	Recommended EC	Annual volume (MCM)
Langvlei River	-32.21050 18.37825	E/F	C	C	1.957
Wadrif Wetland	-32.21325 18.37721	F	B	C	1.957
Wadrif Pan	-32.20523 18.33834	E	C	C	5.000
Jakkals River	-32.08942 18.35242	D	C	C	0.352
Jakkalsvlei	-32.08776 18.32152	E	C	C	0.500
Verlorenvlei (Duikerfontein)	-32.61139 18.77444	C	B	C	3.872
Verlorenvlei (Redelinghuys)	-32.46556 18.51667	C	B	B	13.276
Verlorenvlei Lake	-	C	B	B	See Table 2.4

Verlorenvlei River (G30B-E):

- (i) EWR for the Kruismans River (upper mainstem, and the Verlorenvlei River – lowest reach of the mainstem); and
- (ii) EWR (Water Level Specification) for the Verlorenvlei Lake, inclusive of provisional requirements for maintaining acceptable hydrodynamics for maintaining the seasonal connection to the sea (Table 2.4).

Table 2.4 Verlorenvlei Water Level Specification

Component	Requirement/Motivation
Frequency and duration of opening	Twice in any single year (autumn, early winter and spring), or alternatively; and A single extended period from winter through into spring.
Mouth open conditions	“Semi-closed”, i.e. continuous outflow with minimal seawater intrusion.
Water level (Mouth open)	2.20 m AMSL
Water level ()	1.95 m AMSL
Water level (Breaching)	Unknown but less than 2.5 m AMSL

Verlorenvlei is one of the most important estuarine systems in the Western Cape and one of the largest natural wetlands along southern Africa’s west coast. This freshwater coastal lake

is classified as a Ramsar site. Several causeways disrupt hydrological fluctuations, cause siltation and prevent fish migration. Land surrounding the wetland is privately owned and intensive farming practices pose several threats to the surrounding vegetation (grazing, invasive alien vegetation and drawdown of groundwater). The vlei is also infested with alien fish (carp and Mozambique tilapia). Currently, an estuary management plan for Velorenvlei is being compiled by the CSIR (Stellenbosch).

Legal status: Reserves have been signed off by DWAF for the rivers in the following quaternary catchments: G30B, G30C, G30D and G30G. The EWR recommendations for the Verlorenvlei are still under consideration by the DWAF Director-General.

2.2.1.1 Data requirements and activities

In order to include any rivers in the Sandveld for which there are no EWR data in the integrated planning of the Olifants-Doorn WMA, the following data and activities are recommended:

1. *Monthly naturalised hydrological sequences for the river for which there are no EWR data.*
2. *Rapid EWR determinations for those rivers.*
3. *A GIS layer of wetlands needs should be established and then the wetland layer prioritized, particularly with regard to the groundwater linkage to the wetlands. Sensitivity and importance need to be associated with the wetlands and current status determined. For the important and sensitive wetlands monitoring and management mechanisms need to be emplaced.*

2.2.2 Groundwater

The groundwater balance for the Sandveld has been calculated (Refer to Table 2.5). However, there are significant uncertainties associated with groundwater recharge percentage and the Ecological Reserve. In addition, there is significant spatial variation within each catchment. Table 2.5 shows that, in catchment G30F, the amount of groundwater being abstracted exceeds the recharge, and there has been a consequent dropping of groundwater levels in this catchment. Catchment G30E is also of concern as it is also very close to this point, and is also the catchment in which Velorenvlei is located.

There are also many instance of groundwater deterioration across the area, particular where town water supply is concerned. Lambert's Bay, Elandsbaai, Graafwater and some farmers are experiencing deteriorating water quality. There is also some saline intrusion along the coast as a result of over-abstraction.

Table 2.5 Water balance calculation for the area

Catchment	GW Recharge Mm ³ /yr	Reserve BHN Mm ³ /yr	Reserve Ecosystems Mm ³ /yr	Allocatable Mm ³ /yr	GW_Usage Mm ³ /yr	Balance Mm ³ /yr
G30A	No Reserve available					
G30B	15.62	0.0065	2.189	13.42	0.49	12.93
G30C	8.48	0.0005	1.583	6.90	2.78	4.12
G30D	12.38	0.0046	1.131	11.25	4	7.25
G30E	4.45	0.0129	0.16	4.28	2.41	1.87
G30F	13.80	0.0048	0.52	13.28	14.03	-0.75
G30G	11.06	0.0541	0.089	10.91	6.74	4.17
G30H	No Reserve available					

There is only seasonal interaction between surface water and groundwater, and in the hot summer months river flows are negligible. The contribution of groundwater to surface water flows also varies from area to area. For instance, in most sections of the Jakkals River, the river flow recharge the groundwater, i.e., no contribution from groundwater to surface flow. The only section where groundwater feeds the river is between Graafwater and Lamberts Bay. In the Langvlei, downstream of Leipoldtville, groundwater levels are relatively deep are unlikely to be contributing towards surface flow.

For the Velorenvlei, the situation is somewhat different and groundwater contributes to surface flow for long sections of the river, with the longest gaining reach being downstream of the confluence of the Hol, Krom Antonies and Kruismans Rivers, but also at Redelinghuys and in the headwaters.

There are a number of springs that have been identified in the area however, few data are available for these. Four monitored flowing springs in the area are: Klaarfontein; Matroosfontein; Oorwinningsfontein and Janse Kraal. In addition extensive work was completed to model and map where groundwater dependant ecosystems occur in the area.

The delineation of Groundwater Resource Units (GRUs) for the Sandveld was based on: geology (lithostratigraphy and tectonics); topography (and geomorphology); recharge; discharge; groundwater elevation and flow directions; and groundwater use. Six GRUs have been defined for the study area. The GRU have been further subdivided into an upper (U), central (C) and lower (L) portion (Table 2.6).

The surface systems are not confined to GRUs, and there is groundwater flow between GRUs.

The specific component of the Ecological Reserve addressed by groundwater is the maintenance low flow in the dry season, and the allocations required per GRU are shown in Table 2.7. Table 2.7 also shows that, with current levels of abstraction, there is insufficient

groundwater remaining to meet the Ecological Reserve lowflows for the Verlorenvlei (GRU 2), the Langvlei (GRU 5) and the Jakkals River (GRU 6) catchments. Also, there is more water is being abstracted from the lower Langvlei and Wadrif groundwater resource units (GRU 4 and 5) than is available.

In addition, no groundwater abstraction should be permitted within 250 m of these systems.

Legal status: Groundwater Reserves have been signed off by the DG DWAF for the G30A, G30B, G30H and G30G.

2.2.2.1 Data requirements and activities

Groundwater in the Sandveld plays a crucial role in the agricultural sector, the domestic supply sector and sustains ecological functioning.

Notwithstanding its importance, the quantity of groundwater used by the agricultural sector has not been quantified. Estimates have been made of this use using remote sensing but these should be ground-truthed with detailed water use metering.

Detailed groundwater level monitoring should be implemented across the Sandveld – using a well-distributed network of boreholes, should be done every three months, with a complete analysis of the groundwater quality of selected boreholes every 12 months. This is particularly important in the areas where groundwater abstraction is high, and in coastal abstraction schemes. In addition, rainfall gauges should to be equipped with automated data loggers, and all municipal production boreholes should be equipped with volume meters.

Table 2.6 Groundwater resource units - surface areas (km²) and associated quaternary catchments

GRU	Area (km ²)	Quaternary catchments	Geology	Key features	Present Status	Water resource category	Proposed desired state	Proposed management class
1	779.5	G30B	Malmesbury Group	Kruismans River, little groundwater abstraction	B	Good	C	Good/fair
2	1,031.5	G30D, G30E	Malmesbury, Klipheuwel and Table Mountain Groups, some significant geological structures, including the Redelinghuys Fault	Hol, Krom Antonies, Kruismans and Velorenvlei Rivers; secondary and primary aquifers occur, contains Velorenvlei and Elandsbaai water supply wellfields, Redelinghuys	C	Good/fair	A	Excellent
3	97.2	G30E		Characterised by significantly different groundwater chemistry - high in Total Dissolved Solids	B	Good	D	Fair
4	478.6	G30C, G30F, G30G		Bergvallei River, Wadrif salt pan Wadrif aquifer and the Lambert's Bay water supply wellfield	E	Poor	B	Good
5	816.0	G30C, G30F	Table Mountain Group and Quaternary deposits, large SE/NW faults and cross-cutting E/W faults	Kleinvlei, JanseKraal, Alexandershoek and Lambertshoek Rivers, Leipoldville	D	Fair	C	Good/fair
6	742.4	G30G	Lower Table Mountain Group and significant Quaternary deposits	Jakkals River, Jakkalsvlei, Graafwater and Lambert's Bay towns, Graafwater aquifer and SGWCA	C	Good/Fair	C	Good/fair

Table 2.7 Groundwater Reserve and allocation per Groundwater Resource Unit

GRU	Total Recharge (MCM/a)	Total Abstraction (MCM/a)	Reserve (MCM/a)	Groundwater Available for Allocation (MCM/a)
1	11.266	0.244	1.751	9.272
2L	1.403	0.000	0.032	1.371
2U	14.370	0.619	6.163	7.587
3	0.907	0.017	0.005	0.886
4C	2.081	0.000	0.011	2.070
4L	-0.243	0.931	3.267	-4.440
4U	4.910	0.750	0.023	4.137
5L	3.232	1.399	1.948	-0.115
5U	17.768	1.540	13.206	3.022
6L	1.331	0.158	0.946	0.228
6U	6.721	1.383	1.957	3.380
Total	63.746	7.040	29.308	27.398

Hotspots where groundwater levels and groundwater quality are deteriorating have been identified, and urgently need management intervention to reduce groundwater abstraction.

Several of the GRUs also require urgent attention:

- 1. The most critical is GRU 4 (Lower Wadrif) as it has excessively reduced water levels and poor water quality. Groundwater abstraction has resulted in groundwater levels that are lower sea level, and abstractions should be reduced as soon as possible. This is a key GRU for monthly groundwater level and water quality (EC) monitoring. In addition, a complete analysis of groundwater quality in the production boreholes should be done every six months.*
- 2. GRU 2 (Lower Velorenvlei, and including the Elands Bay wellfield) is also critical. There is ongoing deterioration of groundwater quality in the area, which appears to be linked to well-field management rather than to over-abstraction. This issue requires further investigation to remedy the problem. This is a key GRU for monthly groundwater level and water quality monitoring. In addition, a complete analysis of groundwater quality in the production boreholes should be done every six months.*
- 3. In GRU 5 (Lower Langvlei, and including the Leipoldtville wellfield) declining water levels and deteriorating water quality have been reported. Monthly groundwater monitoring should be done here and abstraction decreased.*
- 4. The current levels of abstraction from the Graafwater wellfield (GRU 6; Lower Jakkals) are sustainable, but this is a key GRU for monthly groundwater level and water quality (EC) monitoring. In addition, a complete analysis of groundwater quality in the production boreholes should be done every 12 months.*

2.3 Biodiversity Planning

Two biodiversity planning exercises have relevance for the Olifants-Doorn WMA, each at a different level of detail. These are:

- A 2006 freshwater biodiversity plan for the entire Olifants-Doorn WMA.
- The C.A.P.E. fine-scale plan, which was a 2008 integrated terrestrial and freshwater fine-scale biodiversity plan for portions of the Olifants/Doorn WMA.

The 2006 WMA-wide biodiversity plan is at a coarser scale than the C.A.P.E. fine-scale plan, and wherever there is overlap, the C.A.P.E. plan should take precedence.

Legal status: Only really enforceable in that they were done within DEAT/SANBI's mandate to plan for biodiversity targets in terms of NEMBA.

2.3.1 The 2006 freshwater biodiversity plan for the Olifants-Doorn WMA

The 2006 freshwater biodiversity plan for the Olifants-Doorn WMA was commissioned by DWAF, and undertaken in parallel to the development of the WRCS. Its purpose was to explore how freshwater biodiversity planning outputs could be incorporated into the WRCS.

- Sub-quaternary catchments of biodiversity priority were identified on the basis of achieving explicit biodiversity targets for 78 river ecosystem types and 12 indigenous freshwater fish species. River types were described using unique combinations of Level 2 Ecoregions (Kleynhans *et al.*, 2005), hydrological index categories (Hannart and Hughes, 2004) grouped to describe permanent/seasonal/ephemeral rivers, and geomorphological zones (Rowntree and Wadson 1999).
- The resulting map of biodiversity priorities showed four management zones:
 - “**Freshwater Focal Areas**” that are needed to achieve biodiversity targets and should be managed in a state of high ecological integrity (preferably A or B ecological category)⁴;
 - Acknowledging the connected nature of freshwater ecosystems, Freshwater Focal Areas were augmented with “**Critical Management Zones**”, which need to be managed in a state that supports the maintenance of Freshwater Focal Areas (usually C, sometimes a D, depending on the function it was selected for and the sensitivity of the system; however this is not explicitly dealt with in the biodiversity plan);

⁴ It should be noted that the terminology being used for freshwater biodiversity planning and the water resource ecological reserve determination is at times in conflict and needs to be resolved

- Any sub-quaternary catchment containing a Freshwater Focal Area or Critical Management Zone was assigned to a “**Catchment Management Zone**” indicating that the river, wetlands and smaller stream in the sub-catchment should be managed as an integrated unit; and
- “**Critical Restoration Zones**” that should be regarded as strategic rehabilitation areas were also identified.
- Only systems currently in an A or B ecological category were selected as Freshwater Focal Areas, unless they could be rehabilitated. In these instances, they were assigned to the Critical Restoration Zone category.
- Two maps were produced showing biodiversity priority sub-quaternary catchments:
 - A biodiversity priority map that considered rivers and indigenous freshwater fish species, which was used as input into the testing of the WRCS and is the basis of Figure 2.2; and
 - A biodiversity priority map that considered rivers, indigenous freshwater fish species and wetlands. Owing to limitations in delineating wetlands and automating their classification into different ecosystem types, the level of confidence of this biodiversity priority map is lower than the one for rivers only.

2.3.2 The C.A.P.E. fine-scale plan

The C.A.P.E. fine-scale planning region for the freshwater component of the project was aligned to nearest quaternary catchment boundaries of the terrestrial planning domain (Figure 2.2). The coinciding quaternary catchments in the Olifants-Doring catchment are not available.

- Separate biodiversity priorities at a sub-quaternary catchment scale were first identified for the achievement of biodiversity targets for rivers and indigenous freshwater fish species (layers downloadable from the SANBI BGIS site: <http://bgis.sanbi.org/fsp/wcoastRivers.asp>).
- The fish sanctuaries used for this plan were the same as for the Olifants-Doorn WMA-wide biodiversity plan. The river types used differed slightly in the way hydrological variability was classified – instead of using hydrological index categories to identify permanent, seasonal or ephemeral rivers, the 1:50 000 Surveys and Mapping rivers GIS layer was used to assign a flow variability of “Permanent” or “Not Permanent”, where the former commonly lumps permanent and seasonal rivers, and the latter refers to ephemeral rivers.
- This was done because the scale of the hydrological index is at a quaternary level, and a finer scale resolution was needed to classify the flow variability of the smaller streams within quaternary catchments. Information used for river types and freshwater fish species was the same as for the Olifants-Doorn biodiversity plan.

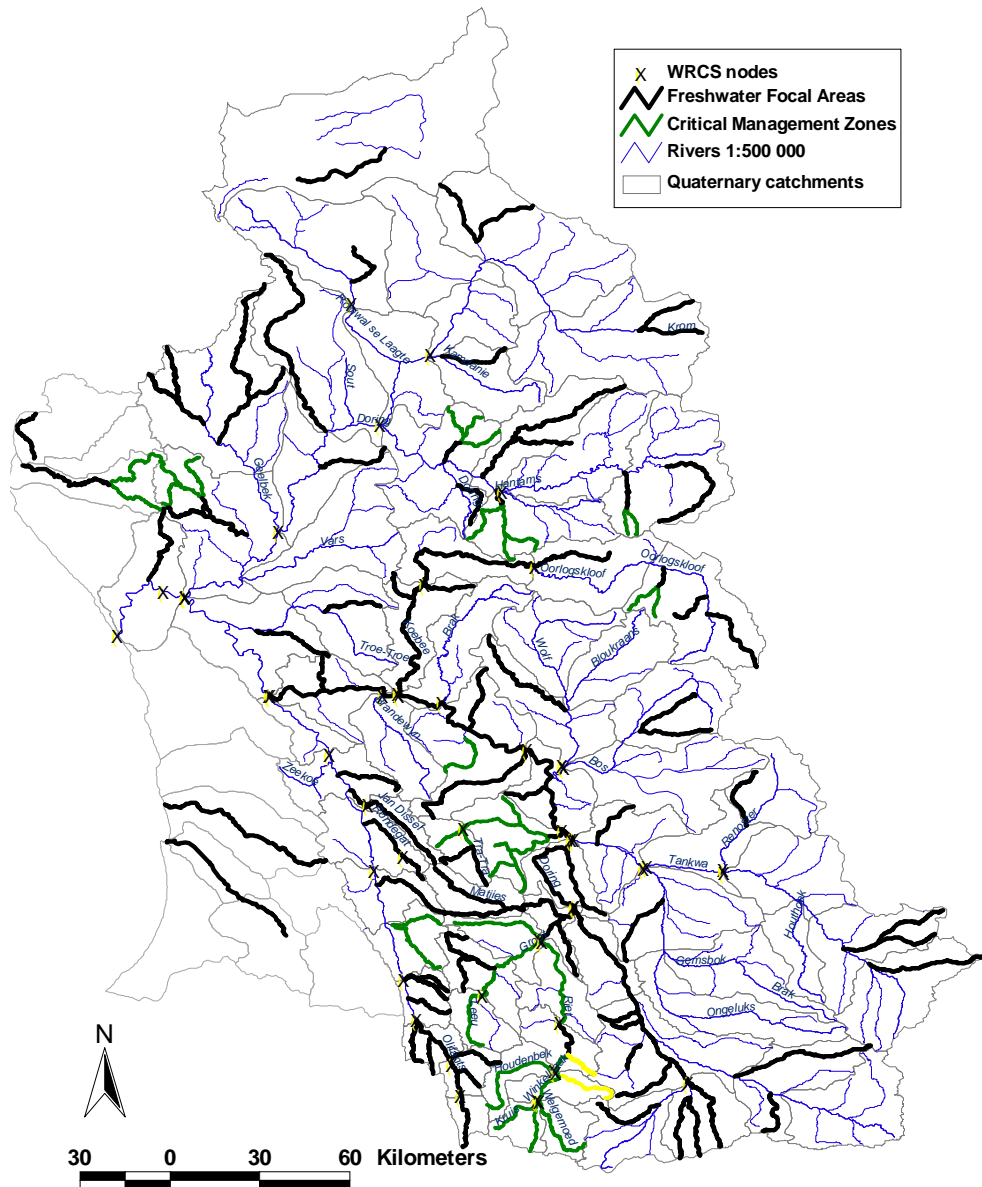


Figure 2.2 Rivers in the Olifants-Doring Catchment that were identified as being important from a biodiversity perspective in the 2006 freshwater biodiversity plan (Nel *et al.* in press).

- The final integrated terrestrial and freshwater biodiversity plan was then produced using the priority sub-quaternary catchments above to guide the selection of additional priority areas for achieving biodiversity targets of wetlands, vegetation types and species of special concern.
- Zones were also assigned in the CAPE biodiversity plan such that “Critical Biodiversity Areas” (CBA) were analogous to the Freshwater Focal Areas in the WMA-wide plan and “Ecological Support Areas” were analogous to Critical

Management Zones. No Critical Restoration Zones were identified, but when a CBA is lower than an A or B category, it is recommended that it should be rehabilitated.

2.3.3 Other initiatives

There are several other initiatives of particular value to resource protection in the WMA, in terms of information and sources of guidance, these are:

- The National Strategic Biodiversity Assessment;
- The Fynbos Forum Ecosystem Guidelines for detailed guidance on development planning; and
- The Fine-scale Planning Users' Guidelines (under development).

2.3.4 Implications for additional EWR data

Tributaries identified as biodiversity targets in the 2006 freshwater biodiversity plan for the entire Olifants-Doorn WMA, for which there are no EWR data are listed in Table 2.8, and illustrated in Figure 2.3. Those for which environmental water requirements are most needed are highlighted in bold in Table 2.8. Most of the remaining rivers are either in extremely dry parts of the catchment, where flow is intermittent, or in areas where further development is unlikely, such as in the mountain areas.

The biodiversity planning for the Olifants-Doorn WMA is not complete, and would need to be finalised prior to Classification. Furthermore, although incomplete these existing plans indicate that there are likely to be some mismatches between available hydrological and EWR data and hydrological and EWR data required before the biodiversity targets can be incorporated into the Classification Process. Should it not be possible to collect the data it may be appropriate to identify these tributaries as “no development zones” and thereby fix the usage at existing lawful use levels thereby fixing the EWR contribution.

Table 2.8 Tributaries identified as biodiversity targets in the 2006 freshwater biodiversity plan for the Olifants-Doring Catchment, for which there are no EWR data. Priority tributaries are in bold.

Quat.	Nearby Node	River	Tributaries selected in the 2006 freshwater biodiversity plan for which there are no EWR data
E10B	R 44	Olifants	Visgat and De Molen, tributaries to Olifants
E10C	R 42	Olifants	Ratel and Oudste, tributaries to Olifants
E10D	R 40	Olifants	Voorste and Agterste, tributaries to Olifants
E10E+F	R 33	Olifants	Heks, tributary to Olifants
E10J	R 23	Olifants	Kliphuis tributary to Olifants
E21E	R 43	Riet	Noname, tributary to Riet
E21H	R 38	Groot	two arms of Twee Riviere, tributary to Groot

Quat.	Nearby Node	River	Tributaries selected in the 2006 freshwater biodiversity plan for which there are no EWR data
E21K	R 37	Matjies	Kromrivier, tributary to Matjies
E21L	R 37	Groot	Noname, tributary to Groot
E22B	R 36	Groot(B)	Muishond and Bella se Laagte, tributaries to Groot B
E22C	R 50?	Doring	Bloedrivier tributary to tributary of Doring
E22D	R 50	Doring	Kolkies and Karee tributaries to Doring
E22E	R 36	Doring	Vleirivier, Beukesfonteinrivier and 2 nameless tributaries to Doring
E22G	R 28	Doring	Brakfonteinspruit, tributary to Doring
E23A	R 32	Tankwa	Brakrivier, tributary to Tankwa
E23B	R 32	Tankwa	Knoffelhoeks, tributary to Tankwa
E23E	R 31	Renoster	Noname tributary to Renoster
E23J	R 30	Ongeluks	Tandskoonmaak se Laagte, tributary to Ongeluks
E23K	R 27	Tankwa	Noname tributary to Tankwa
E24A	R 25	Tra-Tra	Dassieboskloof, tributary to Tra-Tra
E24C	R 21	Bos	Biesrarivier and Oliewenbos se Rivier, two arms of tributary to Bos
E24G	R 22	Wolf	Soutpans, tributary to Wolf
E24H	R 20	Doring	Biedourivier, tributary to Doring
E24J	R 19	Doring	Groot-Avontuur and Duiwelsleegte, tributaries to Doring
E24M	R 14	Doring	Noname tributary to Doring
E31A	none	Saraip	Schalk se Laagte, tributary to Saraip
E31B	R 2	Krom	Noname tributary, top of Krom.
E31C	R 2	Krom	Saadkraal (two arms)-tributary to Krom.
E31F	none	Kamdanie	Noname tributary to Kamdanie (near witvlakte)
E31G	R 1	Rooiwalse Laagte	Oubeespan, tributary to Rooiwal se Laagte, just upstream of R1
E32A	R 4	Hantams	Wolfkloofs and Kransgat tributaries to Hantams (top of Hantams)
E32C	R 4	Hantams	Klein-Toring, tributary to Hantams below R4
E32E	R 3	DoringB	Krom, Tributary to DoringB above confluence with Hantams. Noname tributary to Hantams above confluence with DoringB.
E33A	R 5	Doring	Spitskop tributary of Sout downstream of junction with Doring
E33B	R 5	Sout	Noname tributary of Sout upstream of R5
E33D	R 5	Geelbek	Klein Riet and Klein Riet trib both tribs of Geelbek, Geelbek joins Sout just downstream of R5
E33E	R 8	Sout	Rooiberg between R8 and R5 (tributary to Sout).
E33F	R 9	Troe-troe	Langkloof tributary to Troe-Troe
E33G	R 9	Troe-troe	Wiedou – tributary to Troe-Troe
E33H	E	Olifants	Droëkraal se Leegte between E and R7
E40A	R 12	Oorlogskloof	Droë, Vlakfontien se Rivier and noname, tributaries to Oorlogskloof
E40B	R 12	Oorlogskloof	Noname tributary to Oorlogskloof
E40D	R 17	Koebee	Klein-Koebee and de Hoop – tributaries to Koebee

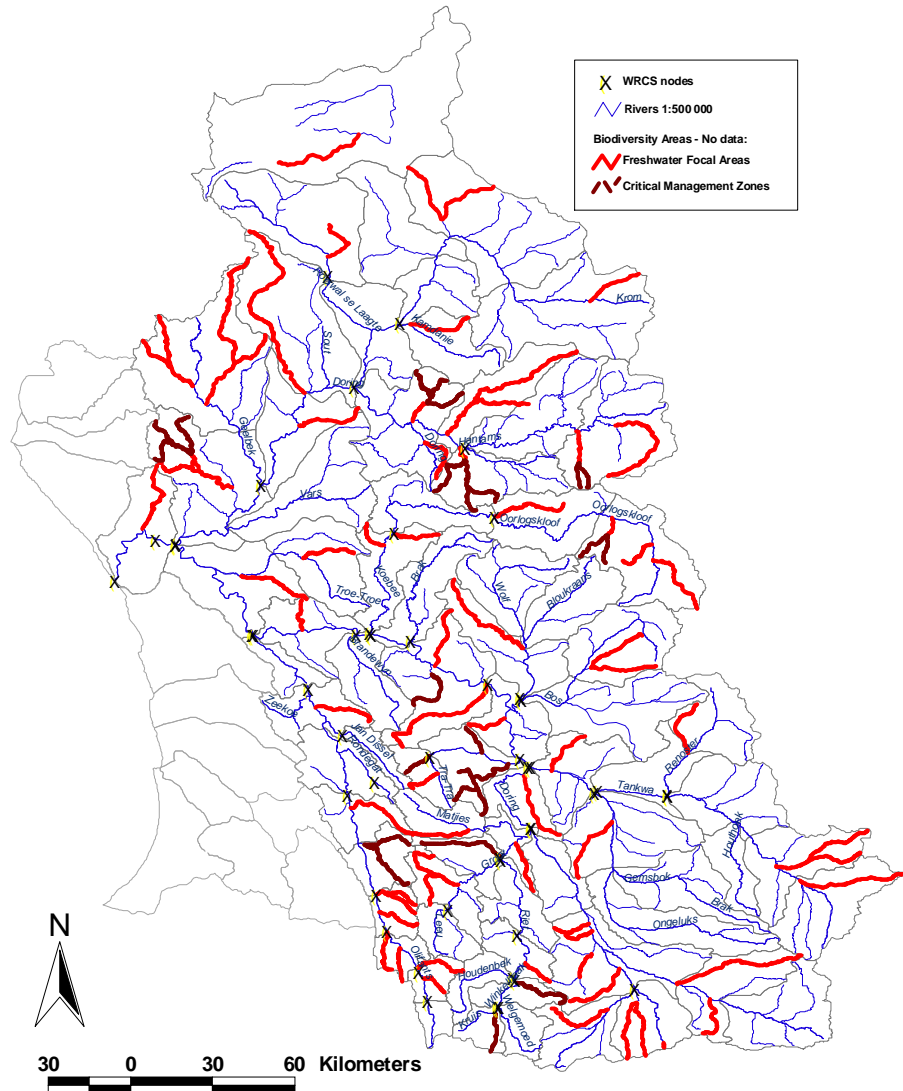


Figure 2.3 Tributaries selected in the 2006 freshwater biodiversity plan (Nel *et al.* in press), highlighting in red and red-brown those for which hydrological information is unavailable.

Other mismatches are also evident. For example, in some cases a reach has been given a relatively low Reserve EC (based on PES), but was identified as important for biodiversity protection. This was the case with, for example, the Jan Dissels (lower reaches have a Reserve EC = D), the Matjies (EC of C) and sections of the Riet (EC of C) (Figure 2.4). Also, several smaller tributaries in the E3 secondary catchment area were highlighted as important, but most of the reaches here were given an EC of C. This means that some assessment as to whether or not a C category would support the envisaged level of biodiversity conservation is needed before the plan can be finalised.

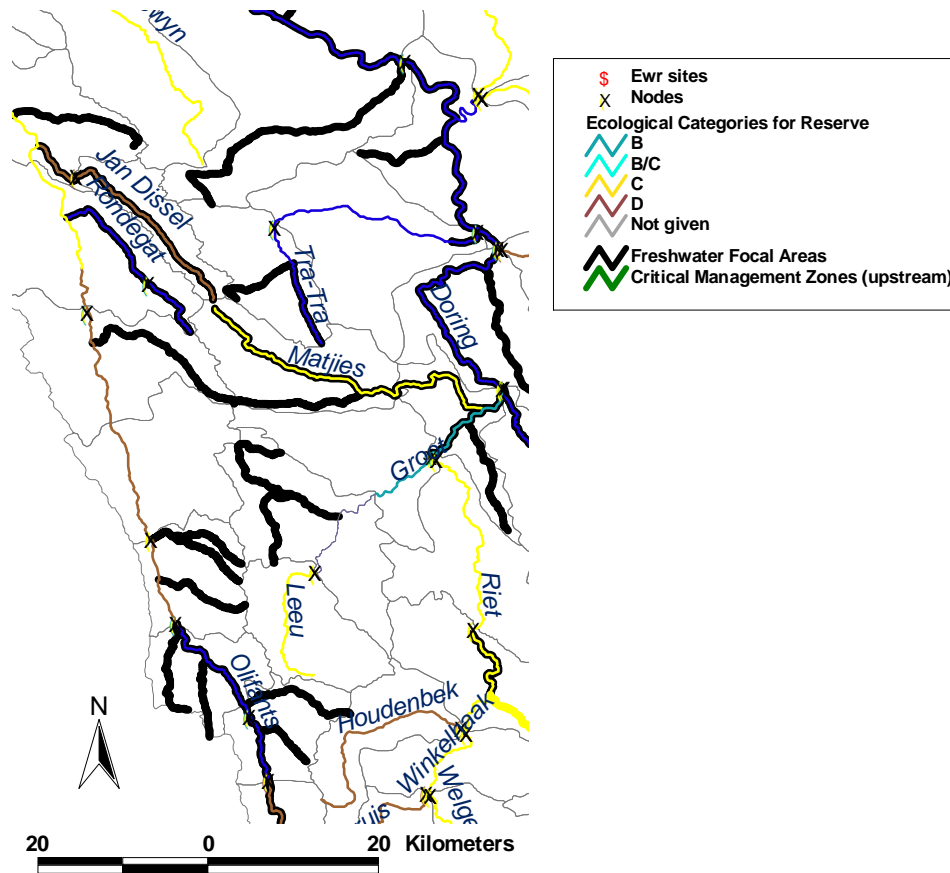


Figure 2.4 Detail showing a mismatch between Ecotatus Categories (EC) from EWR studies and those from the biodiversity planning initiatives, which will need to be resolved. In this case rivers that were assigned a low EC (C or D) were also selected as Critical biodiversity areas.

2.4 Geographical Information System

In order to visually explore and gain perspective of the various aspects that pertain to water resource protection in the Olifants-Doorn WMA, relevant GIS data files were collated. The information was gathered from a wide range of sources, and files used include data detailing surface water and groundwater reserve studies, fine and broad scale planning of sensitive aquatic areas, as well as general and orientation data.

Data files were grouped into three broad categories:

- Surface water, data detailing the status or conservation priority of rivers, estuaries or wetlands;
- Groundwater, groundwater assessment information as well as detailed information of groundwater-related data in the Sandveld area; and
- General, files such as quaternary catchments, rivers, wetlands and roads can be found.

The names of the files used, and a brief description of each is given in Appendix E.

ArcGIS 9.2 was used for collation of the data. A map document OD_CMS.mxd was created from which all of the data can be viewed and referenced. As a large amount of diverse information is included, many of the layers are by default not set as visible. The Surface water\od_nodes shapefile's attribute table contains a field: Info_Link that contains a relative path to a document detailing details of the preliminary reserve and resource class for each of the nodes. Hyperlinks to these documents have been created and can be viewed in versions of ArcMap 9. The relevant documents are stored and can be accessed from the Documents folder.

2.4.1 Data requirements and activities

During collation of GIS data the following main shortcomings were identified:

- *Incomplete coverage of the OD WMA for crucial shapefiles pertaining to water resource protection;*
- *A lack of metadata for non-generic files used.*

Ideally, in order to easily identify sensitive areas/features, standardised coverage and attribute data for each significant component representative of the entire WMA would be preferable. For example the following quaternary catchments, groundwater reserve information have not yet been established: F60A, F60C, F60B, F60D, F60E, G30H, E10K, E10J, E10G, G30A, E10F, E10E, E10D, E10C, E10B, and E10A. Similarly surface water reserve information included is not representative of the entire WMA.

Metadata, detailing for example attribute fields of the significant, non-generic data included, could not be compiled given the limited time frame, but would be highly informative for the end-user, ensuring correct interpretation and use of the data.

2.5 Classification

A Water Resource Classification System (WRCS, Dollar *et al.* 2006) has recently been Gazetted for South Africa (Government Gazette No. 999, 08 September 2008). The WRCS is a set of guidelines and procedures (Figure 2.5) for determining the different classes of water resources, and is required in terms of the National Water Act (NWA, No. 36 of 1998,

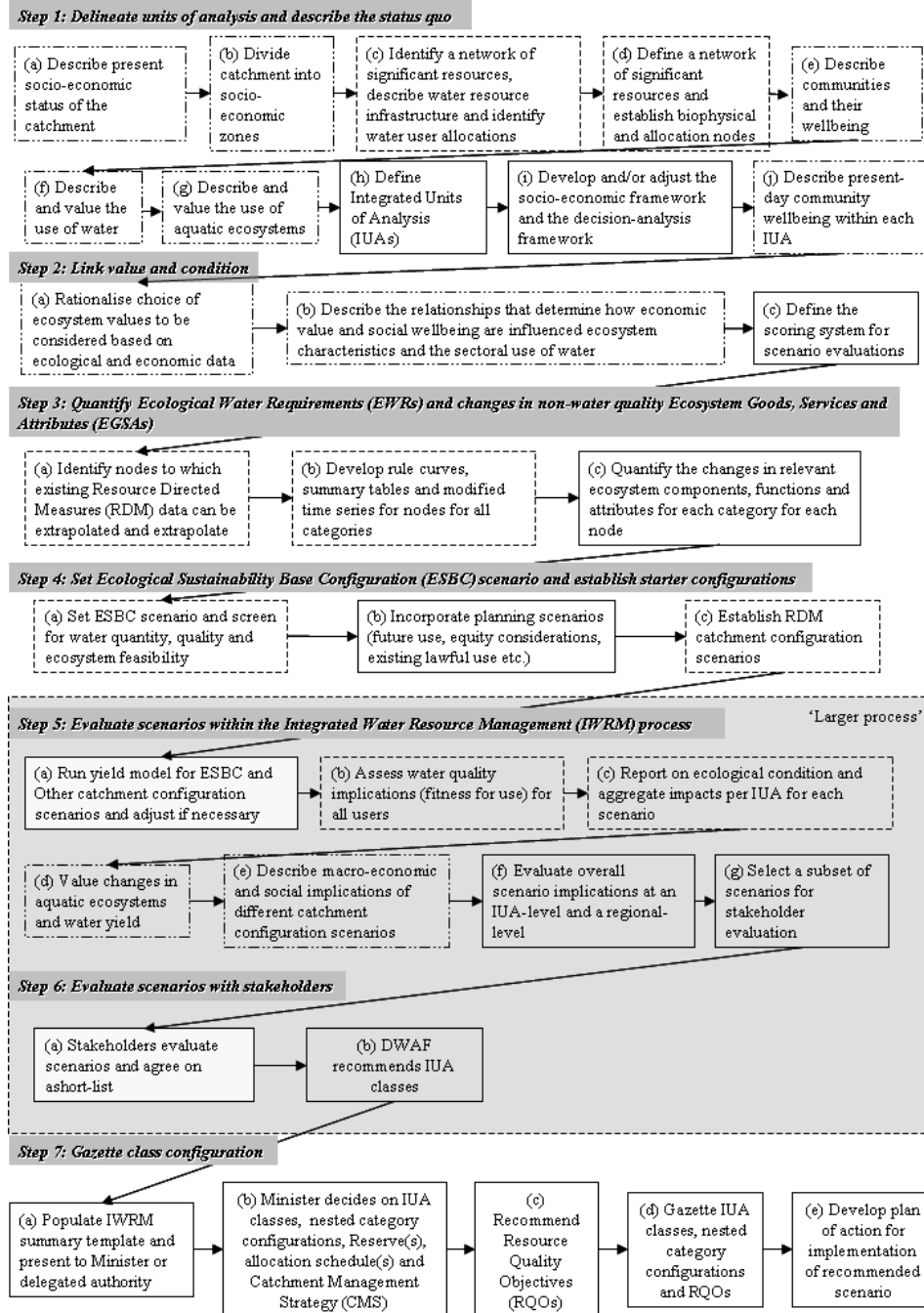


Figure 2.5 Proposed 7-step classification procedure as defined in the WRCS (note that Steps 5 and 6 form part of a ‘Larger Process’).

Chapter 3, Part 1, Section 2(a)). The WRCS will be used in a consultative process (Classification Process) to classify the water resources of catchments throughout South Africa. The outcome of the Classification Process will be a Management Class (MC),

Reserve and Resource Quality Objectives (RQOs) for geographical groupings of significant water resource (rivers, estuary, wetlands and aquifers).

The WRCS is based on the principle of sustainable development as is entrenched in the South African Constitution. The National Water Act (1998) indicates that water-resource management must:

- Meet the water needs for current and future generations;
- Promote the efficient, sustainable and beneficial use of water in the public interest; and
- Protect aquatic and associated ecosystems and their biological integrity.

Eventual MCs will be:

- Defined for each sub-catchment within the WMA (known in the WRCS as Integrated Units of Analysis [IUAs]; Brown *et al.* 2006);
- Defined in terms of the use that will be made of water resources in an IUA (Table 2.9); and
- Comprised of a configuration of aquatic ecosystem conditions, resulting in an ‘overall condition’.

Table 2.9 Definitions of Management Classes.

<p>Class I: Minimally used The configuration of water resources within a catchment results in an overall water resource condition that is minimally altered from its pre-development condition.</p>
<p>Class II: Moderately used The configuration of water resources within a catchment results in an overall water resource condition that is moderately altered from its pre-development condition.</p>
<p>Class III: Heavily used The configuration of water resources within a catchment results in an overall water resource condition that is significantly altered from its pre-development condition.</p>

The guidelines used to determine the overall MC for a sub-catchment from a configuration of ecological conditions are outlined in Table 2.10.

The Olifants-Doring Catchment was used as a ‘proof-of-concept’ catchment for the development of the WRCS. This means that, although a Classification Process has not been conducted, much of the information required for such a process has already been generated for the Olifants-Doring Catchment. Similarly, a considerable amount of work has been done in determining the EWRs for rivers and groundwater in the Sandveld.

Table 2.10 Preliminary guidelines for determining the IUA class for a scenario (after DWAF, 2006).

IUA class		Percentage Ecological Category (EC) representation at units represented by biophysical nodes in an IUA				
		≥A/B	≥B	≥C	≥D	<D
Class I		≥40	≥60	≥80	≥99	-
Class II		-	≥40	≥70	≥95	-
Class III	Either	-	-	≥30	≥80	-
	Or		-	-	100	-

That said, it is important to note that the WRCS is necessarily an integral component of the IWRM environment. This means that the Classification Process is linked to other processes in the integrated planning of water resource protection, development and utilisation, and in the management and control of water use. Thus, there are additional information requirements for a Classification Process pertaining to socio-economic issues in the catchment, which are not highlighted in classification system documents. These are, however, explained in detail in the WRCS documentation (specifically Dollar *et al.* 2006 and Joubert *et al.* 2006).

It is important to understand that a Classification Process seeks to classify the water resources within a catchment, i.e. rivers, wetlands, groundwater and estuary. It does not seek to classify the catchment. The outcome of the Classification Process will, however, influence the water yield from the resources, and although it does not dictate catchment activities, such as land use, these may well be affected by the outcome.

2.5.1 Data requirements and activities

In order for a Classification Process to be undertaken in the Olifants-Doorn WMA, the following data and activities are required:

- *All those listed in Sections 2.1 to 2.5;*
- *Implement Classification Process; and*
- *Define RQOs for agreed Management Class configurations.*

The estimated timeframes for the classification procedure are presented in Table 2.11. The timeframes presented for each step assume that all the external information required for the Classification Process (e.g. allocation scenarios, Reserve information) is available.

Table 2.11 Estimated timeframes for the WRCS steps for Olifants-Doorn WMA.

Step number	Estimated time required in months
1	3
2	3
3	3
4	3
5	2
6	6
7	3

2.5.2 Strategic-level decisions related to the raising of Clanwilliam Dam and the implementation of the Ecological Reserve

The decision to raise Clanwilliam Dam necessitated several strategic level decisions with respect to new water-resource development elsewhere in the catchment and implementation of the Ecological Reserve.

No Reserve releases are currently made from the Clanwilliam Dam but, according to the Water Act (1998), raising of the dam wall would trigger the requirement for Reserve releases from the dam. Thus, in the feasibility studies for raising of Clanwilliam Dam, a series of options were assessed that involved adjusting releases from Clanwilliam Dam to mitigate to the extent possible the impact on the downstream river without affecting yield, and keeping releases from Bulshoek Barrage to the minimum, so that water supply from Clanwilliam Dam and Bulshoek Barrage was maximised.

Because the agriculture relies so heavily on the water resources of the WMA, the introduction of an onerous Reserve in terms of additional required releases from Clanwilliam Dam/Bulshoek Weir would have had significant negative implications for the irrigated agriculture sector. The DWA deemed the raising of the Clanwilliam Dam to be the most viable option for mitigating socio-economic impacts of implementing the Reserve, while at the same time providing significant additional economic benefits.

The decision to raise Clanwilliam Dam accepted that there will be no additional water released from the dam to supply the Reserve, and had the following implications for other parts of the basin:

- No major developments in the Doring River, as this water is required to maintain the Doring River in a good ecological condition (B-category) and maintain the C-category in the estuary, which has a significant socio-economic importance primarily because it is used as a nursery area for economically-important marine fish.

- Maintain the ecological integrity of key tributaries on both the Olifants and Doring Rivers, thereby ensuring variability of flow, as well as provision of refuges and source areas.
- Reduce non-flow related impacts in the mainstem Olifants River between the Olifants Gorge and Clanwilliam Dam, thereby improving overall river condition in this reach.
- Reduce water quality impacts in the mainstem Olifants River downstream of the confluence with the Doring River. This will also improve the quality of water entering the estuary.
- Control over-fishing in the estuary.

Because the Doring River will remain undammed and continue to provide flows to the estuary, it was also unnecessary to create large outlet capacity for a raised Clanwilliam Dam, thereby reducing construction and operating costs. A multi-level release structure will, however, be installed to mitigate impacts of current releases on the downstream river, as low temperatures inhibit yellowfish spawning.

2.6 Resource Quality Objectives

A Water Research Commission project aimed at producing guidelines for establishment of Resource Quality Objectives (RQOs) for aquatic resources and other users is currently underway. It is being undertaken by the Institute of Natural Resources and is scheduled for completion in 2010. It is thus, premature to include recommendations for the establishment of RQOs in this report, but the guidelines should be available to guide the establishment of the RQOs once Classification has been completed in the Olifants-Doorn WMA (see Section 2.5).

2.6.1 Resource Quality Objectives for the protection of aquatic ecosystems

The outcome of the Classification Process will be the setting of the class, Reserve and RQOs by the Minister or delegated authority for every significant water resource (river, estuary, wetland and aquifer) under consideration. In the WRCS it is recommended that RQOs be established as part of Step 7 (Figure 2.5) as it is inefficient to establish RQOs for a whole suite of possible outcomes.

2.6.2 Resource Quality Objectives for other sectors

RQOs related to the quantity and quality of water used or discharged will also need to be established for other water-use sectors, and should form part of the sub-strategies for these sectors.

3 Institutional arrangements

3.1 Relevant legislation

The legislation that guides water resource protection stems from multiple government departments. The most directly relevant pieces of legislation and the departments mandated to implement each are listed in Table 3.1.

Table 3.1 Relevant pieces of legislation and the departments mandated to implement

Relevant legislation	Mandate
Acts	
National Environmental Management: Biodiversity Act (Act 10 of 2004)	SANBI/DEAT
National Environmental Management: Protected Areas Act (Act 57 of 2003)	DEAT
National Environmental Management Act (NEMA) (Act 107 of 1998) ⁵	DEAT
Water Services Act (Act 108 of 1997)	DWAF
National Water Act (Act 36 of 1998)	DWAF
Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983)	DoA
Nature and Environmental Conservation Ordinance (Ordinance 19 of 1974)	DEA&DP
Mountain Catchment Areas Act (Act 63 of 1970)	DWAF
Seashore Act (Act 21 of 1935)	DEAT
Conventions and Agreements	
Convention on Biodiversity (signed 1993)	DEAT
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) (signed 1975) Verlorenvlei is the Ramsar site within the WMA	DWAF
Convention on migratory species of wild animals (Bonn Convention; 1995)	DEAT
Policies	
National Biodiversity Strategy and Action Plan (2004)	DEAT
National Spatial Biodiversity Assessment (2004)	DEAT/SANBI
Western Cape Environmental Implementation Plan	All organs of State
Coastal Policy for the Western Cape (2000)	DEAT (MCM), WC gov
Bioregional Planning Framework to WC Province (2000)	SANBI/DEAT
National Water Resource Strategy (2002)	DWAF
Internal Strategic Perspective – Olifants-Doorn WMA (2005)	DWAF

3.1.1 The importance of cooperative governance in IWRM

Water resource protection requires co-operative governance to a larger degree than many other areas of catchment management due to overlapping or parallel mandates and limited budgets, making it neither desirable nor cost-effective for the various institutions with

⁵ As amended in terms of the National Environmental Management Amendment Act (No 62 of 2008).

mandates pertaining to the management and protection of water resources to operate independently of one another. The Co-operative Governance Strategy and Communication Strategy must engage with this issue to support Water Resource Protection and develop actions to ensure appropriate action.

Examples of areas requiring cooperative governance (and rationalisation) in the Olifants-Doorn WMA include:

- The determination of EWRs (DWAF mandate - partly) to achieve biodiversity targets (DEAT and SANBI mandate).
- The integration of biodiversity targets (DEAT and SANBI mandate) into the catchment planning via the Classification Process (DWAF mandate).
- The impact of irrigation runoff (DoA mandate through the Co-ordinating Committee for Agricultural Water (CCAW)) on water quality in freshwater aquatic ecosystems (DWAF mandate) and the estuary (DEAT mandate).
- Establishment of a Marine Protected Area for the Estuary ((DEAT mandate).
- Rehabilitate and management of estuarine habitat damaged by historic mining operations and estuarine fisheries by phasing out gill net fishing in the estuary to protect nursery grounds (DEAT mandate).
- Monitoring Reserve compliance and efficacy (DWAF mandate), river health (DWAF/CapeNature dual mandate) and monitoring biodiversity targets (DEAT and SANBI mandate).
- Ensuring that local government representatives are aware of and implementing RQOs.
- Engage with Department of Health and Department of Agriculture regarding integration of programmes affecting water quality and pragmatic, shared monitoring.
- Regulatory authorities to co-ordinate efforts -National Dept Agriculture, DWAF and DEA&DP regarding conditions to control permits/authorizations provided especially relating to water quality requirements and modification of bed and banks of river.
- Integration of programmes such as LRAD (Land Affairs), Source Directed Measures (DWAF) and planning processes such as Integrated Development Plans (IDP) and strategic Development Frameworks (Local Municipalities).

3.2 Roles and responsibilities

Annexure D provides the details of the government institutions that play a role in water resource protection within the Olifants-Doorn WMA. Table 3.2 lists the roles and responsibilities related to these organizations.

Table 3.2 Roles and responsibility.

Function	Responsibility/ Mandate
Environmental Water Requirements – Olifants-Doring Catchment <ul style="list-style-type: none"> Rivers; wetlands; estuary; groundwater 	DWAF
Resource Quality Objectives	<ul style="list-style-type: none"> DWAF and CMA to take through public participation DWAF to approve
Biodiversity Planning	DEAT and SANBI
Biodiversity Protection Implementation	DEAT, CapeNature, DWAF
Classification	DWAF
Communication/ Ubuntu umuntu nga bantu	CMA, DEAT, DWAF
CMA financing	DWAF & CMA
WMA financing and payment of protection activities	DWAF & DEAT
Private conservation incentives	DEAT
Water use <ul style="list-style-type: none"> Storage; abstraction; licensing; run-of-river abstractions; wastewater disposal 	CMA
General authorizations	DWAF
Beds and banks and Riparian zones	DWAF and DEAT to provide legal provisions, CMA to implement law
Invasive Alien Species	DEAT, landowner, DWAF
Fragmentation	DEAT and SANBI, DWAF
Infrastructure <ul style="list-style-type: none"> Implementation infrastructure Hydrological monitoring Protection infrastructure (e.g. Fish ways) 	<ul style="list-style-type: none"> CMA and DWAF DWAF and CMA DEAT/ SANBI, DWAF, CMA
Monitoring, data storage and reporting Monitoring <ol style="list-style-type: none"> Baseline monitoring Compliance monitoring National Aquatic Ecosystem Health Monitoring Programme Biodiversity monitoring 	<ol style="list-style-type: none"> DWAF CMA DWAF SANBI's –NEM: Biodiversity Act

4 Ubuntu umuntu nga bantu⁶

4.1 Communication for enhanced water resource protection

The nature of water resource protection is such that it spans the mandates of several departments. This creates a priority for clear communication between institutions and organizations with respect to provision of data, action or enforcement of resource protection measures. Cross-department engagement over legal requirements, management and data is critical to reaching agreement on RQOs and implementing and monitoring these.

⁶ A person is a person through other persons.

Organisations involved in water resource management and protection should align their priorities, target setting, approaches to funding, management and monitoring, as well as develop protocols for data sharing.

Efforts to promote, establish and formalize this cooperation should be prioritized and detailed in the CMS Communication Strategy.

4.2 User Awareness

The CMA will implement the CMS through the users. All water users therefore should understand how their actions and usage impact on the resource.

Efforts to promote, establish and formalize the cooperation of users in sustainable resource management should be prioritized and detailed in the CMS Communication Strategy. Specific areas where enhanced user awareness could benefit sustainability are:

- **Classification Process** (see Section 2.5).
- **Enhancement of riparian conservation.** The awareness of the ecological status and state of the catchment and specific aquatic ecosystems including unique and threatened fish species is anticipated to assist conservation efforts especially amongst riparian land-owners.
- **Non-payment and reluctance to pay.** All users should appreciate that water is a shared resource and payment based on use should be rendered for the management thereof.
- **Monitoring results.** Communication of water quality and quantity monitoring results is vital for ongoing cooperative management and use of the water resources in the WMA.

5 Financing and Incentives

5.1 WMA financing and payment of protection activities

The CMA will more than likely rely effectively on the water resource management charges based on water use as well as the waste discharge charges to provide revenue for management of the WMA. The Olifants-Doorn WMA is water stressed and has high biodiversity status and conservation goals, and this finance model could present a distinct challenge in terms of making adequate funding available for resource protection. The principle of user pays and polluter pays are fundamental. In terms of this, water pricing and waste discharge charge systems need to be appropriately implemented. However, recognizing that the natural biodiversity requires a percentage of the limited water resource, at a high quality, and that this maintenance is a critical biodiversity threshold/ target may necessitate other streams of funding to augment costs associated with the management and

protection of these resources, such as national government for biodiversity protection; allocation of waste discharge charges, donor support, payment for ecosystem services, payment for biodiversity services (i.e., from neighbouring WMAs with fewer biodiversity protection areas) and/or private-public incentives.

National government funding or some other funding stream would avoid the biodiversity rich, water-poor WMA being under resourced, and therefore less able to undertake critical resource protection measures in comparison with more water-rich WMAs. It is strongly recommended that the formal consideration, identification and securing of funds to augment and support resource protection activities should form part of the activities in the first five-year period.

5.1.1 Private conservation incentives

The value of private conservation initiatives, such as stewardships, conservancies, biosphere reserves and Sectoral agricultural practice guidelines, is they contribute to catchment management and biodiversity conservation without direct action from the CMA. These initiatives play an important role and should be encouraged to act in support of the CMA activities. The conservation initiatives by landowners such as “Landcare” need to be acknowledged and encouraged through incentives. Further to this, incentives such as a tax breaks should be offered to, for example, reduce water use or forego certain types of development (e.g., leaving riparian buffers undeveloped).

6 Water use

6.1 Storage

The feasibility study for the raising of Clanwilliam Dam (2007) and the earlier Sandveld studies (2006) indicated that there are few options within the Olifants-Doorn WMA that could increase the yield without substantial detrimental impact on the functioning of the freshwater ecosystems in the WMA. The options identified for the Olifants-Doring Catchment included:

- Raising of the Clanwilliam Dam to a maximum height of 15 m; and
- Development of additional farm dams subject to strict control under Catchment Management Plans in the Kouebokkeveld, Citrusdal and Rosendal areas.

Further recommendation with respect to storage in the catchment included:

- No major water resource developments in the Doring River;
- A revision of conditions for farm dam sizes to allow increased off-channel storage leading to decreased summer pumping, to offset the need for summer run-of-river abstraction;

- High environmental impacts means following dams should NOT be considered further:
 - Groot Dam on Groot River; Aspoort Dam on Doring River; Melkboom/Melkbosrug Dam on the Doring River; Grootfontein / Keerom Dam on the Olifants River; and
 - Dams on smaller rivers in the Sandveld (Langveld, Wadrif and Jakkalsvlei) and Rocher Pan catchment – south of Elandsvlei, Palmietfontein River.

Furthermore, any decisions on future impoundments should take cognizance of biodiversity priority areas and catchments (including critical biodiversity layers) (see Section 2.3).

6.2 *Run-of-river abstractions*

Some authorisations in the WMA currently limit the percentage of an allocation that can be stored and this creates a challenge to resource protection as the run-of-river abstraction has led to abstraction during the summer low flow period which compromises the biological functioning of the system. Further to this abstraction infrastructure often causes damage to the bed and banks of the river. Licenses should allow for the storing of 60% of an allocation to allow for the storage of winter water thereby decreasing abstraction pressures on low flows.

Protection of summer baseflow in addition could be enhanced by revisiting concessions to riparian irrigators such as downstream of Bulshoek. Further suggested actions include:

- Revision of conditions of farm dam sizes to allow increased off-channel storage leading to decreased summer pumping and to reduce the cumulative effect of small farm dams in the catchment.
- Development of additional farm dams subject to strict control under a Catchment Management Plan - Kouebokkeveld / Citrusdal / Rosendal areas.
- Surface water reserves to be undertaken for critical biodiversity aquatic areas for Sandveld.

6.3 *Abstraction from the alluvial aquifer*

Abstraction from the alluvial sediments acts as a run-of-river abstraction as it effectively draws riverine water from the system. Some users are undertaking this abstraction under groundwater licenses. Any “groundwater” abstraction from a limited depth and within immediate proximity of the river is effectively abstraction of surface water as such they should be required to obtain a surface water license. A passive compliance approach to this could be to introduce license conditions stipulating a 200-m exclusion zone for groundwater abstraction next to a river or wetland.

6.4 Groundwater abstraction

Aquifer prioritization with respect to over-abstraction, poor management and threat of contamination will be needed to focus interventions to improve groundwater management and resource protection. The installation of monitoring infrastructure in boreholes is key to this. A monitoring network of borehole flows will provide the basis for a comprehensive groundwater monitoring strategy. The CMA will need to provide qualified staff to oversee compliance to license requirements. Appropriate data storage and sharing mechanisms also need to be put in place.

The Groundwater Reserve for the majority of the WMA is poorly defined and limited information is available. For the Sandveld (Quaternary catchments G30B – G20G) the Groundwater Reserves have been signed off. For the remainder of the WMA, the Reserves calculated still need to be validated. RQOs will need to be developed for specific aquifers and prioritized Groundwater Dependent Ecosystems. However, in the short-term groundwater recharge protection zones and exclusion zones can be used to provide a measure of passive compliance, and should be included in all General Authorizations (see Section 6.5). In these areas verification of use should be done prior to consideration of any abstraction licenses. This is also applicable in areas of “stress” (i.e. where groundwater abstraction exceeds groundwater recharge).

Exclusion zones around ecosystems will not work for all the aquifers in the WMA, as many are fractured rock aquifers with complicated, fault-driven, links to surface flow. The contribution of these aquifers is particularly important in the Doring Catchment during the summer months. For this reason, any applications for abstraction of groundwater from the fractured rock aquifers in these areas should be subjected to thorough investigations with the aim of proving that the abstraction would not reduce dry season flow to the rivers.

Specific interventions for the WMA include:

- Identify and map all aquifers used for water supply or that play a significant role in sustaining groundwater dependent ecosystems, and quantify the volume of groundwater being abstracted to see if the Reserve is met.
- Review allocations in Lower Langvlei and Wadrif.
- Implement monitoring and control measures as outlined in Section 2.2.2.

6.5 General authorizations

General authorizations (GA) for surface and groundwater need to be reviewed for the purpose of water resource protection for this WMA (Figure 6.1).

SCHEDULE

1. THE TAKING OF WATER FROM A WATER RESOURCE AND STORAGE OF WATER

Section 1.12

Areas excluded from General Authorisation issued on 26 March 2004 for surface water abstraction (Table 1.1)

E	Olifants River	
	E10A to K	Olifants River above the confluence with the Doring River
	E21	Groot River
G	G30	Verlorevlei River

Table 1.2 Groundwater taking zones: Quaternary Drainage Regions.

Zone A: No water may be abstracted from these drainage regions except as set out under Schedule 1 of the National Water Act

- E22D
- E23C,D,F,G,H,J,K
- E24D,G,H
- E31 – all
- E33A,B,C,D,E,H
- G30A,B,C,D,E,F,G,H

Zone C: 75 m³ per hectare per annum may be abstracted from these drainage regions:

- E21A,B,C,E,L
- E22C
- E24J,K
- E33F
- E40C

Figure 6.1 General Authorisation requirements as per the National Water Act (Act No. 36, 1998).

In particular, GAs need to be more specific for tributaries and certain areas should be excluded from the GAs. This should be guided and integrated with the biodiversity prioritization and the established EWR.

Groundwater GAs need to indicate the aquifer being used, and should consider the cumulative impact of small users. Groundwater abstraction exclusion zones alongside streams, wetlands and other groundwater-dependent ecosystems should also be included in the GAs.

6.6 Disposal of waste water

The disposal of wastewater needs to be controlled from a water resource protection perspective through the Water Quality Reserve and the RQOs set for this. The Preliminary Reserve for Water Quality has been signed off and is therefore legally enforceable, whilst the Water quality (RQO's) Reserve is still to be undertaken and approved. A process for integrating these RQOs into licences must be undertaken as well as compliance and enforcement monitoring. Other protection activities to facilitate implementation of water quality include riparian buffers. It is important therefore to ensure that all new

infrastructure (e.g. WWTW) is set back from a river and that the requisite water use licence, landuse and/or environmental authorizations are in place and provide the legal framework to enforce the protection measures.

It is essential to undertake a pragmatic water quality monitoring programme which utilizes one or two surrogates for water quality as a red flag mechanism. The surrogates should be easy to monitor and not require laboratory analysis e.g. salinity⁷. The Blue Drop and Green Drop strategies currently being implemented should be encouraged and integrated with the preliminary Water Quality Reserve and RQOs. The local authorities will need to be supported to ensure that WWTW facilities comply with requisite General or Special Standard that will increase compliance to RQOs. In parts of this catchment it is important to consider setting RQOs and monitoring for compliance in line with European Union fruit import criteria.

7 Structure and function

Water resource protection is by no means limited to ensuring an adequate supply of water of suitable quality for maintenance of these ecosystems. This section deals with the so-called other aspects of water-resource protection.

7.1 Beds and banks

The bed and banks of rivers and wetlands are protected in terms of the National Water Act (NWA) and the National Environmental Management Act (NEMA). In terms of the National Water Act the “impeding/ diverting river flow” and the “altering bed/ banks of a river” are considered to be water uses that require a license. Listed activities, considered likely to have significant negative impact on the environment and requiring authorization from environmental authorities, include any activities within 32 m of a watercourse. These legal protections recognize the obligations to protect the bed and banks of rivers and should be enforced. The High Confidence Reserve studies specifically noted that removal of riparian vegetation, pumps, in-channel infrastructure and excavation of the river bed have seriously reduced the ecological condition of the Olifants River.

7.2 Riparian zones

The riparian corridor or riparian zone is the interface between land and a river. Plant communities along the river margins are called riparian vegetation. The word "riparian" is derived from the Latin word *ripa*, meaning river bank. Riparian zones are important parts

⁷ DWAF. 2006. Resource Directed Management of Water Quality: Management Instruments. Volume 4.3: Guideline on monitoring and auditing for resource directed management of water quality. Addition 2.

of river systems because they stabilise banks, and act as buffers, protecting the river from sediments, fertilisers, pesticides and other substances washed down off the catchment. They supply shelter and food for many aquatic and terrestrial animals and shade that is important in regulating water and land temperatures.

Research shows that riparian zones improve the quality of surface and sub-surface water draining into the streams, including by absorbing nitrates from fertilizers that could otherwise damage the river ecosystem and human health.

Riparian buffer zones are setback areas of the natural, indigenous riparian vegetation around wetlands and along rivers and streams where no damaging activities are allowed. Buffer zones do not only protect biodiversity, they also protect downstream users.

Buffer zones widths of 32 m from either bank are suggested under NEMA, although many biodiversity planning initiatives have suggested larger buffer zones. It is suggested that rather than providing a set width, the Olifants-Doorn WMA adopt an approach similar to that adopted by the City of Cape Town. This allows for variable buffer widths depending on the size and condition of the river or wetlands, and requires that any new policy provide for appropriate buffer zones on all drainage lines and no new applications are approved within the agreed buffer zones.

Riparian corridors can be reinstated through re-claiming riverside land and re-vegetating these areas with suitable indigenous species. In many parts of the world, rehabilitation of riparian zones has resulted in improved river condition and more reliable low season flows.

7.3 *Invasive Alien Species*

7.3.1 *Vegetation*

The Conservation of Agricultural Resources Act (CARA) requires that landowners remove alien vegetation from their land. The stream-flow reduction properties of many aliens are well known and it is critical that alien vegetation be cleared from riparian areas and surrounding catchments. The NEMA and National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for control of the introduction of new species and an obligation to protect biodiversity from the invasive alien species (including terrestrial and aquatic plants, fish, animals and insects). Ongoing distribution mapping for strategic planning and prioritization is required for biodiversity rich zones and regular maintenance will be required to prevent re-infestation.

7.3.2 Aquatic species

The Olifants-Doring River is one of South Africa's most important river systems for freshwater fish conservation due to the fact that eight of the river system's ten indigenous freshwater fish species are endemic, all of which are threatened (Impson, 2005). Invasive alien fish, including banded and Mozambique tilapia, bluegill sunfish, bass, carp, brown and rainbow trout, have had a significant impact on the biodiversity and ecological functioning of the rivers in the Olifants-Doorn, and are the principal reason for the threatened status of all endemic species in the WMA (River Health Programme, 2006). The future survival of the eight endemics therefore depends not only on the management of water use, but also the effective control and/or eradication of invasive alien fishes in the catchment.

CapeNature and C.A.P.E. are currently underway with efforts to reclaim tributary reaches by eradicating alien fish and re-introducing indigenous species. In this regard, C.A.P.E. have a dedicated Alien Fish Control project, which has identified the Rondegat, Suurvlei, and Krom rivers as priorities for alien fish eradication (River Health Programme, 2006). The removal of alien fish from certain key river reaches to allow for the creation and management of sanctuaries/ refuge areas for indigenous fish must be further investigated and no further stocking of alien fish into dams and rivers should take place in the catchment.

7.4 Fragmentation

Connectivity is widely acknowledged as a fundamental property of all ecosystems (Kondolf *et al.* 2006). In river systems, it refers to the water-mediated fluxes of material, energy and organisms within and between the channels, floodplains, alluvial aquifers and other parts of the ecosystem, and operates in longitudinal, lateral and vertical dimensions, and over time (Ward 1989, cited in Kondolf *et al.* 2006). These connections support and drive ecosystem structure and function, affecting processes such as flow patterns, life-cycle strategies and food supply. Levees, channelisation, incision, dams, barrages, weirs or flow reductions all result in fragmentation of the system, with a concomitant impact on ecosystem functioning, integrity and biodiversity.

Protection of ecosystems in the Olifants-Doorn WMA requires that key connections are maintained, and that limits are set on the sorts of infrastructure or channel manipulations that are acceptable there.

The decision to raise Clanwilliam Dam required that the connectivity between the upper reaches of the Doring and Groot Rivers and the sea be maintained in perpetuity (this will also require the removal of one or two existing weirs) but a wider connectivity assessment

is required that identifies the primary lateral and longitudinal linkages that support the freshwater ecosystems identified for freshwater biodiversity protection. These include:

- The lateral and longitudinal linkages that moderate the flow regime, such as floodplains that attenuate floods, and groundwater links that supply baseflows;
- The lateral and longitudinal movement of animals and plants, such fish migration routes, drift of seeds and larvae, and access to refuge areas; and
- The movement of sediment and other materials through the system.

The integration of a connectivity assessment into conservation plans and CMSs will assist in identifying areas where connectivity must be retained.

It is also important for terrestrial biodiversity that the water resource components of identified conservation corridors are protected to ensure linkages and minimize the fragmentation of natural habitat. For example, the Doring River acts as a link between the Fynbos and Succulent Karoo biomes.

8 Implementation and protection infrastructure

8.1 *Implementation infrastructure*

8.1.1 Hydrological monitoring

There are few operational flow gauging stations in the WMA. These include gauging stations at Clanwilliam Dam, Jan Dissels River, and Troe-Troe River. Gauging stations in the Doring River catchment include Melkboom in lower reaches, Aspoort in Tanqua Karoo area and Leeu River in the upper reaches. Some level recorders exist in the Olifants, Verlorenvlei and Wadrift estuaries. Calibrated sections exist at some points and need to be upgraded. Hydrological monitoring is critical for every aspect of management and resource protection use and this must be rectified. Appropriate information and monitoring must be undertaken prior to new resource use. Additional gauging stations are needed and are planned for Rondegat, Hol, Tanqua, Tra-Tra, Koebee, and Biedou Rivers, as well as at Visgat on the Olifants River. In addition to these, several low flow gauging stations for Reserve requirements are required. These include gauges on the following river reaches:

Doring Catchment

- Twee River at the edge of the escarpment; and
- Groot River near De Mond.

Olifants Catchment

- Olifants River at Citrusdal;
- Olifants River immediately upstream of Clanwilliam Dam; and
- Olifants River at Lutzville.

8.1.2 Dam Outlets

Dam outlet structures must contribute to achieving the EWR in terms of flow requirements and water quality. The proposed raising of the Clanwilliam Dam includes a multilevel outlet structure to accommodate temperature and oxygen requirements for fish downstream. Farm dam design should provide for passive compliance with the EWR by providing for example natural low flows to bypass the outlet.

8.2 Protection infrastructure

8.2.1 Fish ways

Nine indigenous fish species (seven of which are endemic) inhabit the Olifants-Doring Catchment. Several of these, including the Clanwilliam Yellowfish, migrate up the rivers to spawn. It is thus vital that effective fishways are installed on in-channel infrastructure, particularly new and existing gauging weirs, to ensure that these do not impede migration of fish and other animals.

8.2.2 Weirs

In the context of the Olifants-Doorn WMA, weirs can play protection role also as barriers to alien species. The identification and management of sanctuary areas for indigenous fish, such as the Clanwilliam Yellowfish Sanctuary (immediately downstream of Clanwilliam Dam), will inform the need for and location of such weirs.

9 Monitoring, data storage and reporting

9.1 Monitoring

Monitoring of ecosystems is a continuing process whereby the status of key ecosystem components are measured at repeated intervals following a disturbance and the results compared with the same kinds of data collected prior to the disturbance.

Once a Management Class configuration has been decided upon (see Section 2.5) and implemented in a sub-catchment/IUA, it will be necessary:

- To establish whether or not the agreed-on IFR is being released (compliance monitoring);
- To verify if the objectives linked to different components of the flow regime are being achieved, e.g., if reed beds are being inundated and maintained by a certain category of flow (efficacy monitoring);
- To verify that the overall objective (i.e. a targeted river condition) is being achieved (river health and biodiversity monitoring); and

- If the overall objective is not being achieved, to be able to adjust either the IFR or the objective (audit monitoring).

In summary, the types of monitoring required are:

Baseline monitoring:	Understanding the natural fluctuations within any ecosystem is essential to successful monitoring. In rivers, changes in the position and extent of sandbars could be natural shifts, well within the long-term norm for a river. Shifts in the species composition of fish communities can occur naturally during dry and wet cycles, around some dynamic equilibrium. A monitoring programme should be able to distinguish between natural and man-made, flow-related or flow-unrelated change. However, distinguishing long-term trends from inter-annual variability requires years of study. In the case of the Olifants-Doorn WMA aquatic resources, the range of natural temporal and spatial variability is not well known, and so monitoring will have to contribute to this knowledge rather than feed on it. Globally, this is by no means an unusual situation. Limited data collection has already taken place during the EWR studies (see Section 2.1 and 2.2), various other studies and the River Health surveys (see below), which can be used to augment the baseline understanding.
Compliance monitoring:	Refers to monitoring that the agreed Ecological Reserves for the estuary, wetlands and individual river reaches are being met in terms of both their annual and monthly volumetric requirements and the distribution of those volumes in time, i.e., lowflows and floods. It is predominantly hydrological monitoring, but may also include resource monitoring compliance to Resource Quality Objectives, water quality.
Efficacy monitoring:	Refers to monitoring of specific components of the flow regime to determine whether in fact the requested Reserves are meeting their objectives. For instance, is the magnitude, timing and duration of the flood requested for channel maintenance such that it does in fact maintain the channel? This kind of monitoring is required to inform adaptive management, and adjustment of the Reserve requirements should this become necessary. At this stage it is uncertain who will be responsible for efficacy monitoring, but it may be something that would be suitable for funding by the Water Research Commission.

Biodiversity monitoring: Refers to the monitoring of the status of and trends in South Africa's indigenous species, and on a species by species basis. It is one of SANBI's compulsory functions under the National Environmental Management Biodiversity Act (NEMBA) to monitor and report on the status of South Africa's biodiversity, and SANBI has a monitoring and reporting unit dedicated to this function.

The National Aquatic Ecosystem Health Monitoring Programme: A national monitoring programme managed by DWAF's Resource Quality Services. The most well-known component is the River Health Programme (RHP). The goal of the RHP is to serve as a source of information regarding the ecological state of river ecosystems in South Africa, in order to support the rational management of these natural resources.

See: www.dwaf.gov.za/iwqs/rhp/naehmp.htm.

Refer to Section 2.5.2 and Table 2.8 for the recommended prioritization of river monitoring, based on 2006 freshwater biodiversity targets and EWR requirements.

The degree of success of a monitoring programme is directly linked to its overall design and funding. Programmes that are well funded are likely to be more successful, as there is a clear commitment to support them, and paid specialists are employed to drive the programme. Many a well-intentioned plan fails simply because it is nobody's paid job to make it work, and everyone else is too busy to do it part-time. Funds for monitoring programmes should thus be secured and realistic, as part of the revenue derived from the dam, so that a long-term monitoring plan can be made and implemented.

For this to happen, there is a need to synchronise and rationalize the various monitoring efforts in the Olifants-Doring WMA to reduce repetition and redundancy. If monitoring activities are designed with care most of the different types of monitoring can make use of the same data sets or, at least, the data for many of them can be collected at the same time.

Furthermore, it is highly likely that some of the monitoring will require the construction of new infrastructure and some calibration thereof before monitoring can take place. For instance, there is a dearth of hydrological monitoring stations in the Olifants-Doring Catchment, and numerous stations (10-30) will be required for effective compliance monitoring of the Ecological Reserve. Many of these will probably take the form of rated sections (i.e., not gauging weirs) fitted with data loggers, however, in the absence of Classification it is premature to discuss the number, location or nature of the required monitoring infrastructure.

9.2 Data storage and reporting

A data-storage and reporting strategy is essential to resource protection and a sub-strategy covering this in detail is required in the CMS.

10 Summary of key recommendations for completion within the next five years

Within the next five years, the CMAs in the CFR will have been established, with the compilation of CMSs as one of their first responsibilities. In the Olifants-Doring WMA there are some key information requirements and activities that should be completed in the next five years as they would greatly enhance the ability of the CMA to compile the Water Resource Protection Sub-strategy, and without which it will be extremely difficult, if not impossible, to do. These have been addressed in some detail in this report but are summarized here.

10.1 Integrated planning for freshwater resources

- Determine EWRs for the remaining significant water resources (NWA 1998).
- Finalise freshwater biodiversity planning and integration of biodiversity targets into the EWR determinations.
- Implement a Classification Process for the Olifants-Doorn WMA.
- Define the Resource Quality Objectives for significant aquatic resources in the Olifants-Doorn WMA.

10.1.1.1 Environmental Water Requirements

Rivers:

The following data and activities are required:

- Monthly naturalised hydrological sequences for key tributaries.
- Field-based assessments of PES and EIS for key tributaries.
- Extrapolation of EWR information to key tributaries.

Wetlands:

The following data and activities are required:

- An inventory of wetland in the WMA and prioritization of wetlands for protection and/or rehabilitation.
- Wetland EWR assessments.
- Exclusion buffers for groundwater abstraction.

Groundwater:

The following data and activities are required:

- Collation of groundwater Reserve information.
- Quantification of groundwater use.
- Implementation of groundwater monitoring across the WMA.
- Urgent interventions to reduce abstractions and improve management in hotspots (see Section 2.2.2).

10.1.1.2 Biodiversity Planning

The following data and activities are required:

- Resolution of confusing and conflicting terminology between freshwater biodiversity planning and the DWAF RDM processes.
- Completion of biodiversity planning for the Olifants-Doorn WMA. This will require resolving mismatches between available hydrological and EWR data.
- Resolution of other evident mismatches freshwater biodiversity planning.

10.1.1.3 Geographical Information System

The following data and activities are required:

- Standardised coverage and attribute data for each significant component of the WMA.
- Compilation of metadata.

10.1.2 Ubuntu umuntu nga Bantu

Improve communication between all stakeholders in the WMA, specifically with respect to the Classification Process; enhancement of riparian conservation, non-payment and monitoring results.

10.1.3 Financing and Incentives

Investigate WMA financing and payment of protection activities with the aim of ensuring that these will be adequately financed.

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