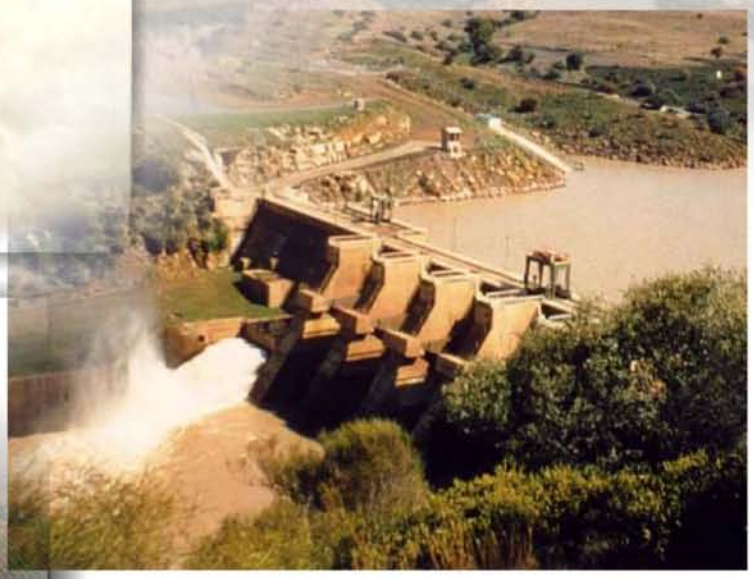
Report Number: P RSA D000/00/0104

DEPARTMENT OF
WATER AFFAIRS AND FORESTRY
Directorate: National Water Resource Planning

Internal Strategic Perspective
Orange River System : Overarching



February 2004

COMPILED BY:

PDNA
PD NAIDOO & ASSOCIATES

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Department of Water Affairs and Forestry
Directorate National Water Resource Planning

INTERNAL STRATEGIC PERSPECTIVE
FOR THE
ORANGE RIVER SYSTEM OVERARCHING (WMAs No 13 & 14)

Title:	*Internal Strategic Perspective for the Orange River System Overarching*
DWAF Report No:	*P RSA D000/00/0104*
Consultants:	*PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3*
Status of Report:	*Version 1*
Version Controller:	*Ms T Malaka (From Central Cluster)*
Date:	*February 2004*

Approved for Consultants by:

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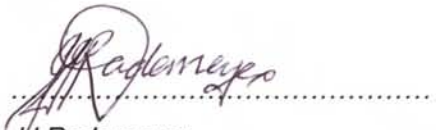
P G van Rooyen
Project Leader

.....

K Haumann
Deputy Project Leader

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
Directorate National Water Resource Planning
Approved for the Department of Water Affairs and Forestry by:



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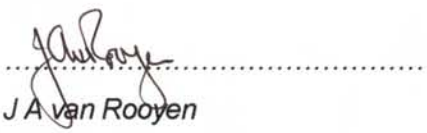
J I Rademeyer
Project Manager



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J A van Rooyen
Manager: NWRP

REFERENCE

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INVITATION TO COMMENT

This report will be updated on a regular basis until it is eventually superseded by the Catchment Management Strategies of the two Orange WMAs. Water users and other stakeholders in the Upper and Lower Orange WMAs and other areas are encouraged to study this report and to submit any comments they may have to the Version Controller (see box overleaf).

ELECTRONIC VERSION

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- DWAF website:
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- On CD which can be obtained from DWAF Map Office at:
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  or from the Version Controller (see box overleaf)

The CD contains the following reports (all available on DWAF website)

- Internal Strategic Perspective Orange River System Overarching (*This Report*) (Report No: P RSA D000/00/0104)
- The National Water Resource Strategy, First Edition 2004
- The Upper Orange WMA - Overview of Water Resources Availability and Utilisation (Report No: P WMA 13000/00/0203)
- The Lower Orange WMA - Overview of Water Resources Availability and Utilisation (Report No: P WMA 14000/00/0203)
- The Upper Orange WMA – Water Resources Situation Assessment

(Report No: P WMA P13000/00/0101)

- The Lower Orange WMA – Water Resources Situation Assessment (Report No: P WMA P14000/00/0101)

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VERSION CONTROL

INTERNAL STRATEGIC PERSPECTIVE ORANGE RIVER SYSTEM OVERARCHING

Version 1	February 2004
(List of Previous Versions)	(Dates)
Current Version Controller	T Malaka Private Bag X995 Pretoria 0001 +27 12 392 1465 malakat@dwaf.gov.za

The most significant amendments included in the latest version will be indicated here.

Internal Strategic Perspective for the Orange River System Overarching

Executive Summary

Introduction

The Overarching Internal Strategic Perspective (ISP) of the two Orange River Water Management Areas (Upper and Lower) is described in this document, and represents the Department of Water Affairs (DWAF) view on how Integrated Water Resource Management should be practiced in these two Water Management Areas (WMAs).

The emphasis in this document is on aspects that are of an overarching nature, presenting strategies that deal with issues resulting from the interdependencies between the two WMAs, which exist due to the upstream-downstream orientation of these WMAs.

Detailed ISPs, one for each of the two Orange WMAs, are presented in separate reports ***(DWAF, 2003e & 2003f)*** *covering water resource management aspects that are specific to each WMA. It is important that these specific WMA ISP reports be read in conjunction with this Overarching document, to obtain a holistic view of the water resource management practices in the Orange River System.*

*The information in the report has been compiled from past studies, but more importantly, it captures the knowledge of DWAF officials that are active in the different spheres of water resource management of the Orange River System. In the drafting of the perspectives or strategies contained in this document, cognisance was taken of the legal requirements of the National Water Act and the strategic direction or framework given by the National Water Resource Strategy (NWRS)****(DWAF, 2003c)****.*

Water resource management is carried out in a changing environment and it should be recognised that this ISP is based on the prevailing situation and conditions at the time of compiling the document. It is the intention of DWAF to regularly update this document to keep the information and strategies relevant.

Overview of the two Orange River Water Management Areas

The Orange River rises in the eastern highlands of Lesotho where it is known as the Senqu River and is the largest and longest river in South Africa. From the Upper Orange WMA, the river flows through the

Lower Orange WMA where it discharges into the Atlantic Ocean some 2 300 km from its origin in Lesotho. The two WMAs making up the Orange River System and the supporting transfers are shown in ***Figures 2.1*** *and* ***2.2.***

Substantial variation in climatic conditions occur over the two catchments, with the Mean Annual Precipitation (MAP) reducing from 1 500 mm in Lesotho and 1000 mm in the RSA in the Upper Orange to 20 mm along the western coast in the Lower Orange WMA. This tendency is reversed when considering potential annual evaporation, which increases from 1200 mm in the Upper Orange to 3000 mm in the Lower Orange water management areas.

Major impetus to modern economic development was given by the discovery of the first diamond in June 1870 near a fountain frequented by early transport riders. This prompted the usual diamond rush and lead to the establishment of the towns Koffiefontein and Jagersfontein. In the Upper Orange WMA Bloemfontein, the capital of one of the former boer republics, later developed into the only city in the Upper Orange WMA. Minerals and water from the Orange River were the key elements for economic development in the Lower Orange WMA. Copper was discovered near Springbok in 1850 and the first diamond in the county in 1866 when a young boy found a transparent stone on the south bank of the Orange River. The first irrigation scheme of note was built at Upington, which was originally established as a trading station for items such as copper, iron, assegais, ivory, skins and tobacco. Construction of the weir at Boegoeberg for irrigation purposes began in 1906. Irrigation development in the Upper Orange WMA was stimulated by the construction of several dams. Great expansions of irrigation was made possible along the Orange River in both WMAs by the construction of Gariep and Vanderkloof dams in the Upper Orange WMA during the 1970's. Two large hydropower stations were also constructed at Gariep and Vanderkloof Dams.

Approximately 6 % of the country's Gross Domestic Product (GDP) originates from this area (5% from Upper Orange WMA & 1% from Lower Orange WMA). The potential for economic growth can be found in the agriculture sector converting to higher value products. Agriculture, mining, trade and Government are the main sectors contributing to the GDP in the two WMAs.

Extensive inter-catchment transfer schemes have been developed for the transfer of water within the water management area as well as to other water management areas. The most significant transfers being from Katse Dam via the Lesotho Highlands Water Project to the Upper Vaal water management area and from Gariep Dam via the Orange-Fish tunnel to the Fish to Tsitsikamma water management area.

The main storage dams in the Orange River WMAs are:

- *Gariep and Vanderkloof Dams on the Orange River (Vanderkloof sub-area), which command the two largest reservoirs in South Africa. Hydropower for peaking purposes is generated at both sites.*
- *Armenia and Egmont Dams on tributaries in the Caledon sub-area. Welbedacht Dam lays on the main stem of the Caledon River, with Knellpoort Dam an off-channel storage dam that supplements the water supply to Bloemfontein.*
- *Rustfontein, Mockes and Krugersdrift Dams are situated on the Modder River, and the Tierpoort and Kalkfontein Dams on the Riet River.*

Katse and Mohale dams in Lesotho are not located in the two WMAs, but have a significant impact on the available water in the Orange River, as the bulk of the water flowing in the Orange River is generated in Lesotho. Katse Dam is located in the Senqu sub-area in Lesotho and is used for the transfer of water to the Upper Vaal WMA. Mohale Dam, which was recently completed are located in the same sub-area, and started to impound water in 2003. This dam is also used to support the transfer to the Upper Vaal WMA.

Resource Availability

Fifty seven percent of the natural runoff is generated in Lesotho and 33% in the Upper Orange WMA and the remaining 10% in the Lower Orange WMA. The bulk of the surface water in the Lower Orange Water Management Area is therefore found in the main stem of the Orange River, with virtually all coming from the Upper Orange Water Management Area. Most of the runoff generated in the Lower Orange is coming from the Fish River in Namibia and is only entering the main Orange River close to the river mouth.

Groundwater is an extremely valuable source in both WMAs and in particular in the Lower Orange WMA where approximately 60% of the water used in the tributary catchments is from groundwater. Although the total volume groundwater used is insignificant in comparison with the surface water resources, groundwater is the only source in large areas.

The surface water resources of the Orange River Catchment have been the subject of various studies aimed at developing and maintaining a reliable hydrological database. The hydrological data that are currently used to operate the system typically covers the period October 1920 to September 1988. There is a fairly high level of confidence in the in the yield estimates of the surface water in the system although some of the hydrology is relatively old.

For effective Integrated Water Resources Management it is required to have a clear understanding of the current and future water resources available in the WMAs. This includes the quantities of usable water in terms of spatial distribution and any factors that may affect the yield of the system and requires an operational analysis on an annual basis. With regards to the resource availability it is required to attend to the following:

- *Assess the need to update the hydrology on a continuous basis and in particular for areas with relative old hydrology and areas where a higher resolution hydrological data and system models is required for local water sources under stress.*
- *The hydrology for the whole system should be updated after the occurrence of a severe drought event. By 2008 it will be possible to extend the shorter hydrology records by another 20 years, which is quite a substantial extension and it recommended to at least re-evaluate the extension of the hydrology at that time if a severe drought event has not occurred before then.*
- *The main variables that impacts on the salinity loads in the system should be assessed on a continuous basis to establish the need to update the TDS model and to commission studies accordingly.*

Water Requirements

Present land use in the area is mostly under natural vegetation with livestock farming (sheep, goats, cattle and some game) with large parts falling within conservation areas. Extensive areas under dry land cultivation, mostly for the production of grains, are found in the north-eastern parts of the water management areas. Large areas under irrigation for the growing of grain, fodder crops, grapes etc. have been developed along the main rivers, mostly downstream of dams.

Irrigation is by far the dominant water use sector in the Orange River WMAs, representing 88% of the total gross water use of 1 996 million m³/a estimated for the year 2000. This figure excludes the transfers out of the WMAs. Only 12% are used by the urban, industrial, mining and rural sectors. Transfers from the Orange amounts to 2 159 million m^3/annum and is mainly from the Upper Orange WMA and Lesotho. Expected future growth will mainly be as result of 12 000ha allocated to resource poor farmers and limited growth in urban/ industrial and mining sectors which will mainly be as result of developments in the Bloemfontein, Thaba 'Nchu area. The projected requirement for 2025 is 2 134 million m³/a excluding the transfers. New transfer schemes out of this area is not expected before 2025.

Water Balance Reconciliation

The supply situation in the Orange River System is such that there is a surplus of 333 million m³/a in the system at the year 2000 development level. This surplus reduce significantly to 158 million m³/a by 2003

with the commissioning of Phase 1B of the Lesotho Highlands Project and will diminish over the next fifteen to twenty years due to the development of the 12 000 ha allocated to resource poor farmers and the natural growth in urban / industrial and mining requirements. At 2025 development level a deficit of almost 50 million m³/a is expected. The surplus is currently used for hydropower generation for Eskom, however, recent analysis indicated that the projected risk of curtailments in the water supply to the consumptive users is such that relatively small allocations can be made for power generation purposes. The utilisation of this surplus by Eskom does not only include the releasing of the available surplus through the hydropower turbines but also operating rules that benefit hydropower generation. These rules typically include the release pattern from Gariep Dam, the storage control curves in both Gariep and Vanderkloof dams, etc. As the surplus in the system reduces over time it will therefore be required to gradually move away from the rules that benefit hydropower generation to ensure that the existing users are supplied at the required risk levels.

Based on the given water balance information, which indicated that intervention measures may be required in the next 15 to 20 years, reconciliation can be obtained through any of or combinations of the following options:

- *Reduction in operational losses in the Orange River System, which are currently estimated at 270 million m³/a. The operating losses can be reduced through improved release management and/or by constructing an operating dam in the Lower Orange.*
- *Water conservation and demand management measures. This would focus on irrigation as the largest water user sector in the system. It is however perceived that most savings will be taken up by the users themselves to expand their irrigated areas.*
- *Utilise the storage volume below the current minimum operating level in Vanderkloof Dam. The effect on hydropower as result of this possible option can be significant and is currently being determined and discussed with Eskom.*
- *Construction of Boskraai Dam in the Orange River between Gariep Dam and the Lesotho border or Mashai Dam in the Senqu. The main emphasis on these dams is to transfer water to the Vaal System but they can also be used to improve the water supply situation on the Orange River.*
- *Additional options from the current Lower Orange Management Study (LORMS) also include the utilising of spills from the Vaal by means of real time modelling and a storage dam at Vioolsdrift or Boegoeberg.*

Water Quality

Water quality of the surface water in the Upper Orange is generally good except for the high sediment load in the Caledon and the salinity problems in the Lower Riet. The water quality in the Lower Orange has, however, been severely impacted upon by extensive upstream developments. It is possible that

the water quality problems in the Orange is coming from the Vaal as water quality in the Vaal becomes worse as one proceed along the Vaal. Under normal operating conditions very little water from the Vaal reach the Orange River and it is mainly under flood conditions that large volumes will enter the Orange. Potentially toxic cyanobacterial bloom events are also occurring in the central region of the Orange River. The water quality issues in the catchment at the over-arching level relate to the management of the water quality passed down between WMAs and can therefore not be solved on a WMA basis alone.

An integrated water quality management tool need to be developed for the Orange River Basin to allow for the rational assessment of the factors that impact on water quality. This is a complex system and water quality will have to be modelled in more detail.

Ecological Reserve Determination

The instream and estuarine flow requirements were determined for the Orange River downstream of Vanderkloof Dam in the Orange River Replanning Study (ORRS) (more or less at intermediate level but the methodology differ from that currently used). These ecological requirements (±280 million m³/a) are currently being released from Vanderkloof Dam. As part of the Lower Orange River Management Study (LORMS), modified Desktop level estimates of the environmental requirements were made for the section of the Orange River from the Vanderkloof Dam to the Orange River mouth as well as for the estuary. These in-stream and estuarine flow requirements are used in the current Lower Orange River Management Study (LORMS) to perform sensitivity analysis. Analysis from the LORMS showed a reduction in the system yield of approximately 100 million m³/a when the modified desktop level environmental flow requirements are used in place of the ORRS environmental flow requirements. A comprehensive Reserve must however still be determined for the Orange River. In the mean time it is essential that proper monitoring must be set in place to monitor the ecological health of the river and the estuary and to collect sufficient data as required for a proper Reserve determination.

Lesotho has determined and implemented updated IFRs for the Senqu River in Lesotho. The updated releases are more than that specified in the original Treaty between RSA and Lesotho on the LHWP and will most likely increase the Orange River System yield by about 30 to 60 million m^3/a while transfers to the Vaal will decrease.

Water Use Management

The operation of this system requires continuous analysis of the projected water requirements, return flows and available surplus as well as communication and liaison with the major users. The system is also operated to manage water quality (TDS) by using blending or dilution. The system therefore requires continuous management of the existing and planned water resource systems to optimally manage the system from an operating cost, water quality and assurance of supply point of view.

Groundwater resources play an important role in the supply of local water requirements in the Orange River system and are therefore discussed in the individual WMA ISP documents.

Essential to the operation and planning of the Orange River System is the record keeping and feedback of water use information, return flow volumes and losses. The lack of accurate water use information for irrigation schemes and low flows in the Orange River main stem has been cited as a cause of concern.

International aspects and implications

The National Departments are responsible to draft and implement strategies and policies regarding international shared river basins. The most important international connections that affects the Orange River System is the Lesotho Highlands Water Project (LHWP), which transfers water from Lesotho and the section of the Orange River along the RSA / Namibia border, where water is abstracted by RSA and Namibian users. Two thirds of the total yield realised by the dams in Lesotho and in the Upper Orange WMA, is transferred to the Upper Vaal and Fish to Tsitsikamma WMAs, and released to the Lower Orange WMA for use by the RSA and Namibia.

The Government of Lesotho has recently commissioned a study to investigate the feasibility of schemes to supply in local water requirements. The impacts of these possible water resource developments in the Lesotho Lowlands on the water balance of the Orange River system must be assessed. The possibility of combined utilisation of future water resource developments should be considered.

Current Namibian requirements are in line with the existing proposed 50 million m³/a permanent allocation to Namibia and 60 million m³/a temporary allocation until 31 December 2007. There are however uncertainties with regards to the growth in the water requirements for Namibia and an agreement with regards to the maximum abstraction and payment of water abstractions by Namibia from the Orange River, needs to be formalised.

It is important to ensure that international water use is based on sound agreements among shared basin states and that current and future water use data are exchanged to facilitate efficient planning and management. The existing agreements and results from the LORMS and Lesotho Lowland study should be used for guidance in this regard.

The communications of issues or future planning will be done at the national level through the appropriate government Department.

System Operation

The utilisation of the water resource is optimised by allowing maximum hydropower generation, without adversely impacting on the long-term reliability of supply to the users in the system. For this purpose operating analysis are undertaken on an annual basis to determine the surplus available in the Orange River System which can be used for the generation of hydro-power over and above that released for normal downstream requirements.

As long as there is still a surplus available in the Orange River System, it would be possible to apply operating rules that benefit hydropower generation without impacting on the reliability of supply of the other users. These operating rules will however have to be adjusted over time to compensate for the increasing transfer from the LHWP and the growth in demands that is imposed on the system.

Monitoring and Information Systems

There are a number of shortcomings that have been identified in the monitoring system. These include water quality, flow measurements to gauge power generation releases, river losses, flows at the Orange River mouth, low flows along the main stem of the Orange River mainly in the Lower Orange, and biomonitoring. A comprehensive water monitoring system needs to be developed to address all the monitoring requirements in the Orange River System.

ISP Implementation Strategy

The implementation of the overarching ISP is expected to take place through the Central Cluster (Cluster Manager) as more than one WMA are under consideration. The Central Cluster incorporates the Gauteng, North West, Free State and Northern Cape Provinces and is responsible for Water Services and Forestry functions within these Provinces and Water Resources Management in the Vaal and Orange basin and the Crocodile-Marico WMA.

The ISP is intended to act as DWAF's perspective on how the Orange River catchment's water resources should be managed. The final ISP will be put out and be open to comments from local authorities, water user associations and other water related forums and interested stakeholders. Mechanisms are to be put in place to capture anomalies and it is intended that formal updates of the document will occur periodically until such time as the Catchment Management Agencies are technically functional and Catchment Management Strategies developed for both WMAs.

Internal Strategic Perspectives for the Central Region: Orange River System Overarching

Table of Contents

ABREVIATIONS

Acronym	Meaning
BP	Business Plan
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
Dir: HI	Directorate: Hydrological Information
Dir: NWRP	Directorate: National Water Resource Planning
CMS	Catchment Management Strategy
Dir: OA	Directorate: Option Analysis
Dir: PSC	Directorate: Policy and Strategic Co-ordination
Dir: WRPS	Directorate: Water Resource Planning Systems
Dir: RDM	Directorate: Resource Directed Measures
Dir: WCDM	Directorate: Water Conservation and Demand Management
Dir: WDD	Directorate: Water Discharge and Disposal
Dir: WUE	Directorate: Water Use Efficiency
DWAF	Department of Water Affairs and Forestry
GDP	Gross Domestic Product
GGP	Gross Geographical Product
IDP	Integrated Development Plan
ISP	Internal Strategic Perspective
LHWP	Lesotho Highlands Water Product
LORMS	Lower Orange River Management Study
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff

Acronym	Meaning
NWA	National Water Act
NWRS	National Water Resource Strategy
ORRS	Orange River Replanning Study
WDM	Water Demand Management
WC	Water Conservation
WMA	Water Management Area
WSDP	Water Services Development Plan
WRPM	Water Resource Planning Model
WRSAS	Water Resource Situation Assessment Study
WUA	Water User Association