Report Number: P RSA C000/00/0103

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

Internal Strategic Perspective
Vaal River System: Overarching

March 2004

COMPILED BY:

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WRP
WATER RESOURCE PLANNING AND CONSERVATION

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Department of Water Affairs and Forestry
Directorate National Water Resource Planning

INTERNAL STRATEGIC PERSPECTIVE
FOR THE
VAAL RIVER SYSTEM OVERARCHING (WMAs No 8, 9 & 10)

Title: *Internal Strategic Perspective for the Vaal River System Overarching*

DWAF Report No: *P RSA C000/00/0103*

Consultants: *PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3*

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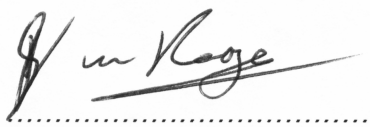

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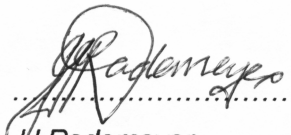

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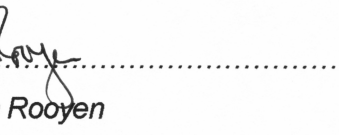

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REFERENCE

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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This report will be updated on a regular basis until it is eventually superseded by the Catchment Management Strategies of the three Vaal WMAs. Water users and other stakeholders in the Upper, Middle and Lower Vaal 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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The CD contains the following reports (all available on DWAF website)

- Internal Strategic Perspective Vaal River System Overarching (*This Report*) (Report No: P RSA C000/00/0103)
- The National Water Resource Strategy, First Edition 2004
- The Upper Vaal WMA - Overview of Water Resources Availability and Utilisation (Report No: P WMA 08/000/00/0203)
- The Middle Vaal WMA - Overview of Water Resources Availability and Utilisation (Report No: P WMA 09/000/00/0203)

- The Lower Vaal WMA - Overview of Water Resources Availability and Utilisation (Report No: P WMA 10/000/00/0203)
- The Upper Vaal WMA – Water Resources Situation Assessment (Report No: P WMA P08/000/00/0101)
- The Middle Vaal WMA – Water Resources Situation Assessment (Report No: P WMA P09/000/00/0101)
- The Lower Vaal WMA – Water Resources Situation Assessment (Report No: P WMA P10/000/00/0101)

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VERSION CONTROL

INTERNAL STRATEGIC PERSPECTIVE VAAL RIVER SYSTEM OVERARCHING

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

Internal Strategic Perspective for the Vaal River System Overarching

Executive Summary

Introduction

The Overarching Internal Strategic Perspective (ISP) of the three Vaal Water Management Areas (Upper, Middle 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 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 three WMAs, which exist due to the upstream-downstream orientation of these WMAs.

Detailed ISPs, one for each of the three Vaal WMAs, are presented in separate reports **(DWAF, 2003b, 2003c & 2003d)** *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 Vaal 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 Vaal 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, 2003d**).*

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 three Vaal Water Management Areas

Substantial variation in climatic conditions occur over the three WMAs, with the Mean Annual Precipitation (MAP) reducing from 800 mm in the Upper Vaal to 500 mm in the Middle Vaal and 100 mm in the Lower Vaal water management areas. This tendency is reversed when considering potential annual evaporation, which increases from 1300 mm in the Upper Vaal to 2800 mm in the Lower Vaal water management areas.

The land use in the Upper Vaal WMA is characterised by the sprawling urban and industrial areas in the northern and western parts of the WMA. There is also extensive coal and gold mining activities located in the Upper Vaal water management area. These activities are generating substantial return flow volumes in the form of treated effluent from the urban areas and mine dewatering that are discharged into the river system. These discharges are having significant impacts on the water quality in the main stem of the Vaal River, throughout all three the water management areas.

The Upper Vaal WMA is economically important, contributing nearly 20% of the GDP of South Africa, which is the second largest contribution to the national wealth amongst all nineteen of the WMAs in the country. The potential for future economic growth in this WMA remains strong. Growth will largely be attracted to the already strong urban and industrial areas in the Johannesburg-Vereeniging-Vanderbijlpark complex.

The Middle Vaal WMA is rural in nature with the land use characterised by extensive dry land agriculture. Irrigation is practiced downstream of dams along the main tributaries as well as at locations along the Vaal River. The largest urban areas are Klerksdorp, Welkom and Kroonstad. The economy of the Middle Vaal WMA contributes about 4% of the GDP of South Africa with the most dominant economic activity being the mining sector, generating more than 45% of the GDP in the WMA. Few of the gold mines in the area have a secure future beyond 2010, although the reserve base could support mining up to the year 2030. The future of gold mining will be strongly influenced by the gold price, exchange rate, operating costs and the tax regime. The declining trend experienced in the recent past is however expected to continue in future in the mining sector. As in the Upper Vaal WMA, mine dewatering and the subsequent discharge to the river system impacts on the water quality.

The land use in the Lower Vaal WMA is primary livestock farming, with some dry land cultivation in the north east. Intensive irrigation is practiced at Vaalharts as well as locations along the Vaal River. Diamond bearing intrusions occur near Kimberley (the most important urban area) and alluvial diamonds are found near Bloemhof. Iron ore and other minerals are found in the south-eastern parts of the WMA.

Due to the extensive development in the Vaal River System and Crocodile (West) WMA, which are supplied from the Upper Vaal WMA, the local surface water resources in all three the Vaal WMAs have been fully exploited, more than three decades ago. It was therefore necessary to augment the supply by developing various schemes transferring water from the Thukela and Usutu to Mhlathuze WMAs, as well as from the Kingdom of Lesotho through the Lesotho Highlands Water Project (LHWP). The three WMAs making up the Vaal River System and the supporting transfers are shown respectively in ***Figures 2.1***, ***2.2*** *and* ***2.3****.*

Water Availability

The surface water availability in the Vaal River System is estimated through a set of water resource models, each fulfilling a particular function in the management of the water resources. Combined, these models serve as a decision support tool that contains a large and comprehensive database of hydrological and physical system characteristics, required to simulate the water resource systems as realistically as possible. The network configuration of the models extends as far as necessary to include all the river systems, which supply the Vaal River System by means of transfers. This water resources modelling and physical network cuts across Provincial, WMA and International boundaries in order to simulate all the interdependencies that exist due to the inter-basin transfers.

The models include water quantity, and water quality in the form of Total Dissolved Solids (TDS) or salinity modelling. The hydrology and water requirement inputs to the models have recently been updated and the water quality model recalibrated. These models are applied to determine the water balance, assess operating rules, assess the need for restrictions during drought periods and to evaluate water quality management options such as blending and/or dilution. The models are also used to determine the implementation dates for future augmentation schemes.

These models were used to determine the water availability for the water balance calculations that are summarised in the relevant section below and described in more detail in ***Sections 2.7.1*** *and* ***2.7.2****.*

Water Requirements

The water requirement scenarios that are currently used for planning originate from the development of the National Water Resources Strategy (NWRS). The total water requirements in the Upper, Middle and Lower Vaal WMAs are 2424, 872 and 643 million m^3/annum respectively. Limited growth in the water requirements is projected for the Middle and Lower Vaal WMAs with the major growth projected for the Upper Vaal WMA. The total water requirements for the Upper Vaal are projected to reach 2903 million m^3/annum by the year 2025, for the base growth scenario.

There are indications that the registered water use, mainly for irrigation purposes, is substantially more than what is currently used in the water resource models. It is therefore essential to compare the data in the model with the verified use once the verification process is completed. (See the strategy on "WATER REQUIREMENTS A.1.2" in ***Appendix A*** *for the proposed management action)*

On an annual basis the recorded water uses are compared to the scenarios and adjustments are made to the short-term projected values where appropriate. During this process, large bulk users such as Eskom, Sasol, Sedibeng Water, Midvaal Water and Rand Water also produce revised water requirement scenarios that are evaluated and considered in the analysis. This process is essential for coherent water resource management and ensures that changes in water use trends are detected on time.

The water requirement scenarios of the Vaal WMAs and other related supply areas must be updated at regular intervals, preferably five yearly. This must be co-ordinated with overall scenarios of population and economic growth for the whole country.

Water Balance Reconciliation

The water balance for the Vaal River System as a whole indicates that for the year 2000, an overall surplus in supply of 19 million m^3/annum is available. With the commissioning of Phase 1b of the LHWP (Mohale Dam and transfer tunnel) during the later part of the year 2003, an additional 320 million m^3/annum (after allowances for transfer losses) is available. This surplus is expected to be gradually depleted over time (to supply the growing water requirements) until a deficit of about 44 million m^3/annum is projected for the year 2025 using the base water requirement scenarios.

*What is important to recognise is that this estimated excess in supply is qualified as "****conditional****" since it is only available if all the transfers are fully operational. In practice the volume of water conveyed through the Thukela-Vaal Transfer scheme will be determined annually, effectively operating the system such that the water demands are in balance with the supply and pumping costs kept to a minimum. The quantity transferred will thus increase over time in line with the growth in the water requirements.*

A further important perspective is that, although the system as a whole will experience surplus conditions over the medium to long term, this surplus is not available in Grootdraai Dam and supporting systems (also referred to as the Eastern Sub-system) due to the physical location of some of the transfer schemes. A pre- feasibility study into the need for augmentation of the Eastern Sub-system showed that further augmentation of this sub-system will be required by the year 2010, or earlier. A number of options have been assessed as possible schemes to augment the supply and the latest

recommendation is that a pipeline should be constructed to convey water from Vaal Dam to support the water requirements of the Eastern Sub-system.

The perspective on possible reconciliation options for the Vaal River System is as follows:

- *Due to the relative low growth rate of the projected water requirements (projected demand curve is relative flat) the impact of even small savings through Water Conservation and Demand Management could result in a substantial postponement of the date that augmentation would be required (i.e. delay the date from 2025 to say 2030 or beyond). It must be noted that, due to the lack of system wide planning information on possible future WDCM measures, the water balance situation presented above do not allow for the impacts of WCDM. This was identified as a gap in the current knowledge and a study is being proposed to collate all planning information on WCDM. (See the **"** WATER CONSERVATION AND DEMAND MANAGEMENT* STRATEGY ***A.4**" in **Appendix A** for details.)*

- *Previous studies indicated that either the Thukela Water Project or a further phase of the LHWP could be implemented as the next water resource development options to augment the supply.*

- *Currently the Comprehensive Reserve has not been determined for the Vaal River System. Since the two factors, releases for the Reserve and WCDM measures are at the opposite sides of the water balance equation, it may be possible (in the short to medium term) to maintain a balance between these two variables by allowing releases for the Reserve to be made with the savings that is achieved by WCDM measures. The first step towards such a strategy would be to obtain reliable planning information on both WCDM and Reserve implication, so that sound motivations and informed decisions can be taken on the way forward. (For more information see the relevant strategies presented in **Appendix A**.)*

*The allocation of the conditional surplus will be managed by the National Department of Water Affairs and Forestry in accordance with the licensing process and adhering to the conditions that are summarised in **Section 2.8.3** and presented in more detail in the "LICENSING A.3.2" strategy given in **Appendix A**.*

With reference to the reconciliation perspectives presented above, their remains many uncertainties regarding the future projected water balance. It is therefore required to assess and update the reconciliation scenarios regularly and inform and involve all users in the selection of the appropriate intervention measures.

Water Quality Management

The water quality varies from poor in the highly developed areas to good in the less developed areas. The water quality is impacted on by point discharges from industries, wastewater treatment works, mine dewatering, irrigation return flows and diffuse sources such as runoff from mining and industrial complexes, agriculture and urban areas. The area is also subject to atmospheric deposition due to emissions from coal fired power stations and industry in and around the catchment.

The current approach adopted in managing water quality is to apply the steps presented below on a sub-catchment basis. The first step is to carry out a situation assessment during which Interim Water Quality Objectives (WQO) are established and water quality variables of concern and sources of pollution are identified. The WQO are based on the water quality requirements of the user sectors as well as from the ecology. The subsequent phases in the process, following the situation assessment,

are to develop water quality management plans or catchment management strategies. During this phase water management interventions such as source control, treatment and dilution are assessed. These phases also involve the revisiting of the WQO in an iterative manner to reach a balance between the water user requirements and achievable management strategies that do not impede continued economic growth.

The cascading characteristic of the three Vaal WMAs has the consequence that the water quality of the main stem of the Vaal River in the downstream WMAs is impacted on, not only by the activities in the WMA itself, but also by the water received from upstream. In addition, the water quality in the Vaal River will also impact on the water quality of the Orange River in the Lower Orange WMA. Due to this inter-dependency it was identified that the current process of managing water at sub-catchment level, should be expanded to integrate management activities across sub-catchments, to meet shared water quality objectives in major tributaries as well as in the main stem of the Vaal River.

In order to deal with the challenges posed by the interdependencies among the Vaal WMAs it is required to commission the development of an Integrated Water Resource Management Strategy for the Vaal and Orange River systems. Such a study need to integrate the WQOs of the sub-catchments, consider the opportunities of implementing the proposed Departmental Waster Discharge Charge System and assess options for water quality management.

Institutional Aspects

The only direct international obligation affecting the water resources of the Vaal River System is in the Lower Vaal WMA, in particular the Molopo River catchment. Since these obligations have a minor impact on the water resources at an Overarching level, further reference to this aspect is given in the Lower Vaal WMA ISP. Institutional aspects on the sharing of the water resources among the Orange River Basin States (Lesotho, Namibia and Botswana) are addressed in the Orange Overarching ISP document.

A further important international institutional link to the Vaal River System is with Lesotho with regards to the transfer of water from the Lesotho Highlands Water Project. The communication of issues and any future planning will be done at the national level through existing institutional structures.

System Operation

Due to the inter dependencies of the Vaal WMAs, the operation of the infrastructure has to be undertaken in a coordinated way to achieve the best efficiencies and balance potential opposing objectives among stakeholders. The main activities for system management include the following:

- *Operation planning should be undertaken on an annual basis. This includes both the water quantity blending and dilution options used to manage the TDS concentration in the Vaal Barrage.*
- *Management during drought periods in accordance with a drought management plan.*

Due to the interlinked configuration of the water resource components in the Vaal River System the responsibility of the operation and management of the main elements will be a function of a dedicated DWAF operations division or a possible Utility. The operation and management of tributary catchments in each WMA will be the responsibility of the respective CMAs.

Monitoring and Information Management

The successful operation of the Vaal River catchment requires effective monitoring networks and information management systems. There is an extensive network of flow, rainfall and water quality monitoring stations in the catchment. However, studies have highlighted the need to expand the monitoring network to include more gauges to determine river losses, bulk distribution system losses, and to track water requirements. Bio-monitoring should be included to assist with the determination and implementation of the ecological Reserve. A consolidated assessment needs to be made of all the monitoring and data management requirements of the Vaal River System. This process should identify all the water resource management activities that require monitoring information, and should focus on the integration of monitoring systems that are directly under control of the Department, as well as from other institutions.

Co-ordination of all monitoring requirements is best undertaken by the WMA managers (currently the regional offices and in future the CMAs). All monitoring requirements for water resource management should be defined by each of the relevant agencies and fed to the WMA managers for co-ordination. For example, monitoring needs that are required for the overarching management and operation of the Vaal River System should be communicated to the each WMA.

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 Vaal River catchment's water resources should be managed. The 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 is technically functional and Catchment Management Strategies developed.

Internal Strategic Perspectives for the Vaal 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
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