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*

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

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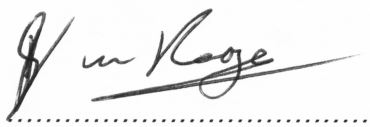

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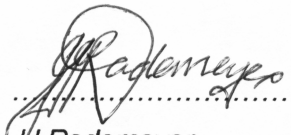

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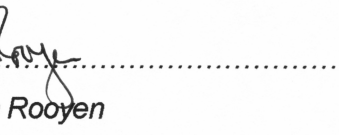

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INVITATION TO COMMENT

This report will be updated on a regular basis until it is eventually superseded by the Catchment Management Strategies of the three Vaal WMAs.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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  or from the Version Controller (see box overleaf)

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

CHAPTER 1: INTRODUCTION

1.1 LOCATION OF THE UPPER, MIDDLE AND LOWER VAAL WMAs

Figure 1.1 shows the location of the Upper, Middle & Lower Vaal WMAs, which covers portions of the Free State, Mpumalanga, Gauteng and North West provinces.

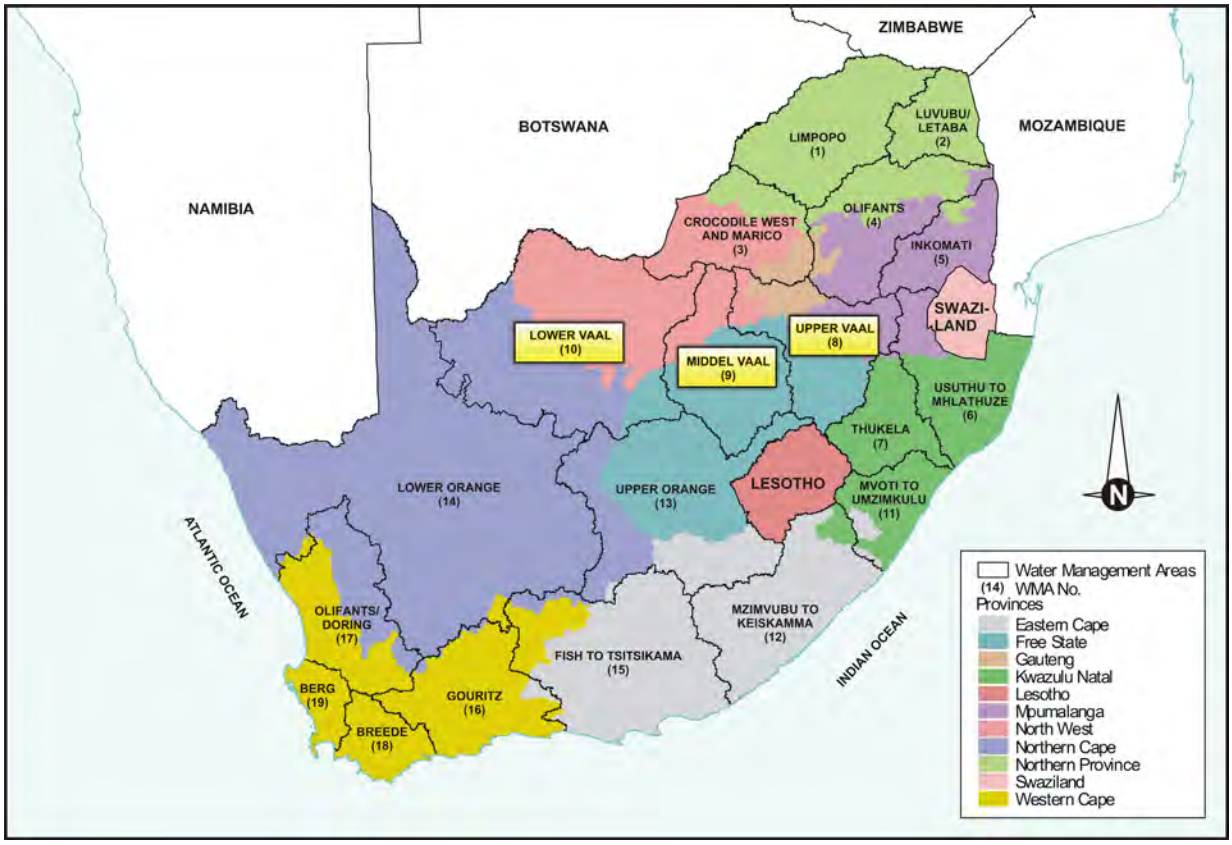

Figure 1.1: Location of the Upper, Middle and Lower Vaal WMAs

1.2 WATER LEGISLATION AND MANAGEMENT

Water is one of the most fundamental and indispensable of all natural resources. It is fundamental to life and the quality of life, to the environment, food production, hygiene, industry, and power generation. The availability of affordable water can be a limiting factor for economic growth and social development, especially in South Africa where water is a relatively scarce resource that is distributed unevenly, both geographically and through time, as well as socio-politically.

Prosperity for South Africa depends upon sound management and utilisation of our many natural and other resources, with water playing a pivotal role. South Africa needs to manage its water resources optimally in order to further the aims and aspirations of its people. Current government objectives for managing water resources in South Africa are set out in the National Water Resource Strategy (NWRS) as follows:

- **To achieve equitable access to water**. That is, equity of access to water services, to the use of water resources, and to the benefits from the use of water resources.

- **To achieve sustainable use of water**, by making progressive adjustments to water use to achieve a balance between water availability and legitimate water requirements, and by implementing measures to protect water resources and the natural environment.

- To achieve efficient and effective water use for optimum social and economic benefit.

The NWRS also lists important proposals to facilitate achievement of these policy objectives, such as:

- Water will be regarded as an indivisible national asset. The Government will act as the custodian of the nation's water resources, and its powers in this regard will be exercised as a public trust.

- Water required to meet basic human needs and to maintain environmental sustainability will be guaranteed as a right, whilst water use for all other purposes will be subject to a system of administrative authorisations.

- The responsibility and authority for water resource management will be progressively decentralised by the establishment of suitable regional and local institutions, with appropriate community, racial and gender representation, to enable all interested persons to participate.

1.2.1 The National Water Act (NWA)

The NWA of 1998 is the principal legal instrument relating to water resource management in South Africa. The Act is now being implemented incrementally. Other recent legislation, which supports the NWA includes the Water Services Act (Act 108 of 1997) and the National Environmental Management Act (Act 107 of 1998).

1.2.2 The National Water Resource Strategy (NWRS)

The NWRS is the implementation strategy for the NWA and provides the framework within which the water resources of South Africa will be managed in the future. All authorities and institutions exercising powers or performing duties under the NWA must give effect to the NWRS. This strategy sets out policies, strategies, objectives, plans, guidelines, procedures and institutional arrangements for the protection, use, development, conservation, management and control of the country's water resources. The purpose of the NWRS is to provide the following:

- The National framework for managing water resources.

- The framework for preparation of catchment management strategies in a nationally consistent way.

- Information, in line with current legislation, regarding transparent and accountable public administration.

- The identification of development opportunities and constraints with respect to water availability (quantity and quality).

1.2.3 Catchment Management Strategies (CMS)

The country has been divided into 19 Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level will be achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA will progressively develop a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA.

The Department's eventual aim is to hand over certain water resource management functions to CMAs. Until such time as the CMAs are established and are fully operational, the Regional Offices (ROs) of DWAF will have to continue managing the water resources in their areas of jurisdiction. Furthermore, the way in which the resources are protected, used, developed, conserved, managed and controlled needs to form an integral part of other planning initiatives at provincial, district and local authority level. These relationships are shown in **Figure 1.2** below.

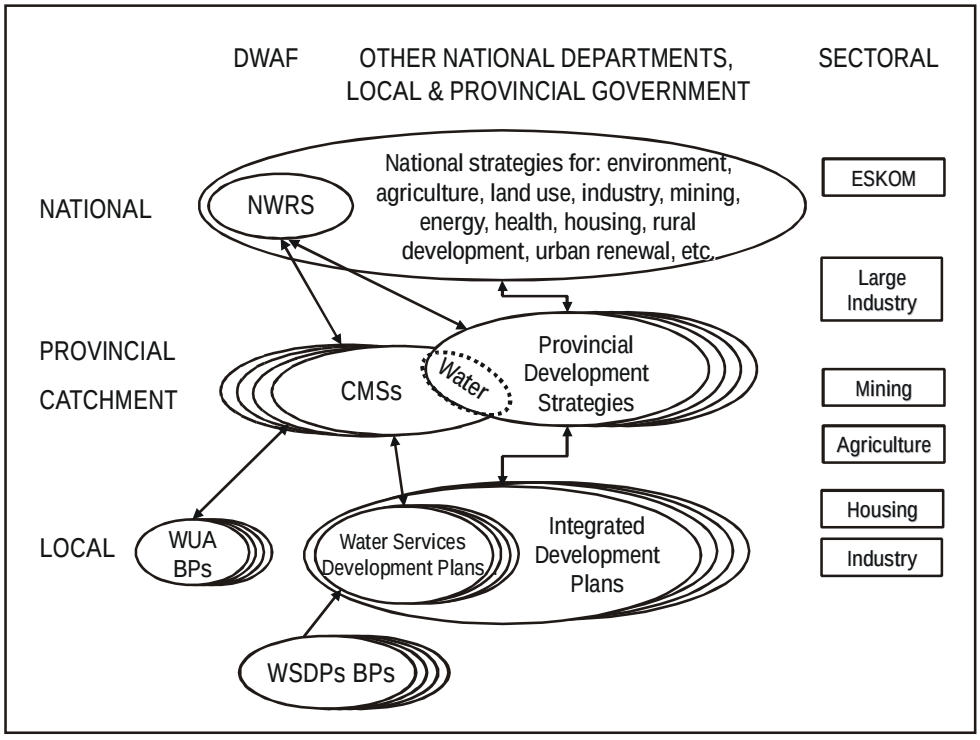

Figure 1.2 : Integrated planning approach at various levels of government in South Africa

1.3 INTERNAL STRATEGIC PERSPECTIVES (ISPS)

1.3.1 The Objectives of the ISP Process

The objective of the ISP will be to provide a framework for DWAF's management of the water resources in each Water Management Area, until such time as the Regional Offices can hand over the management functions to the established CMA. This will ensure consistency when answering requests for new water licences, and informing existing water users (including authorities) on how the Department will manage the water resource within the area of concern. Stakeholders must be made aware of the bigger picture as well as the management detail associated with each specific water resource management unit.

1.3.2 Approach Adopted in Developing the ISP

The detail Water Management Area ISPs for the WMAs in the Central Planning Region was preceded with a process where an Overarching ISP was compiled for the Vaal River System. The purpose of the Overarching ISP was to develop strategies that cover issues related to the three Vaal River WMAs and relates to the interdependency that exists among the WMAs due to their geographical locations relative to each other. The overarching ISPs fall in the same category as the NWRS as it guides the management of water resources affecting more than one WMA while the ISPs for each individual WMA fall in the category of a CMS.

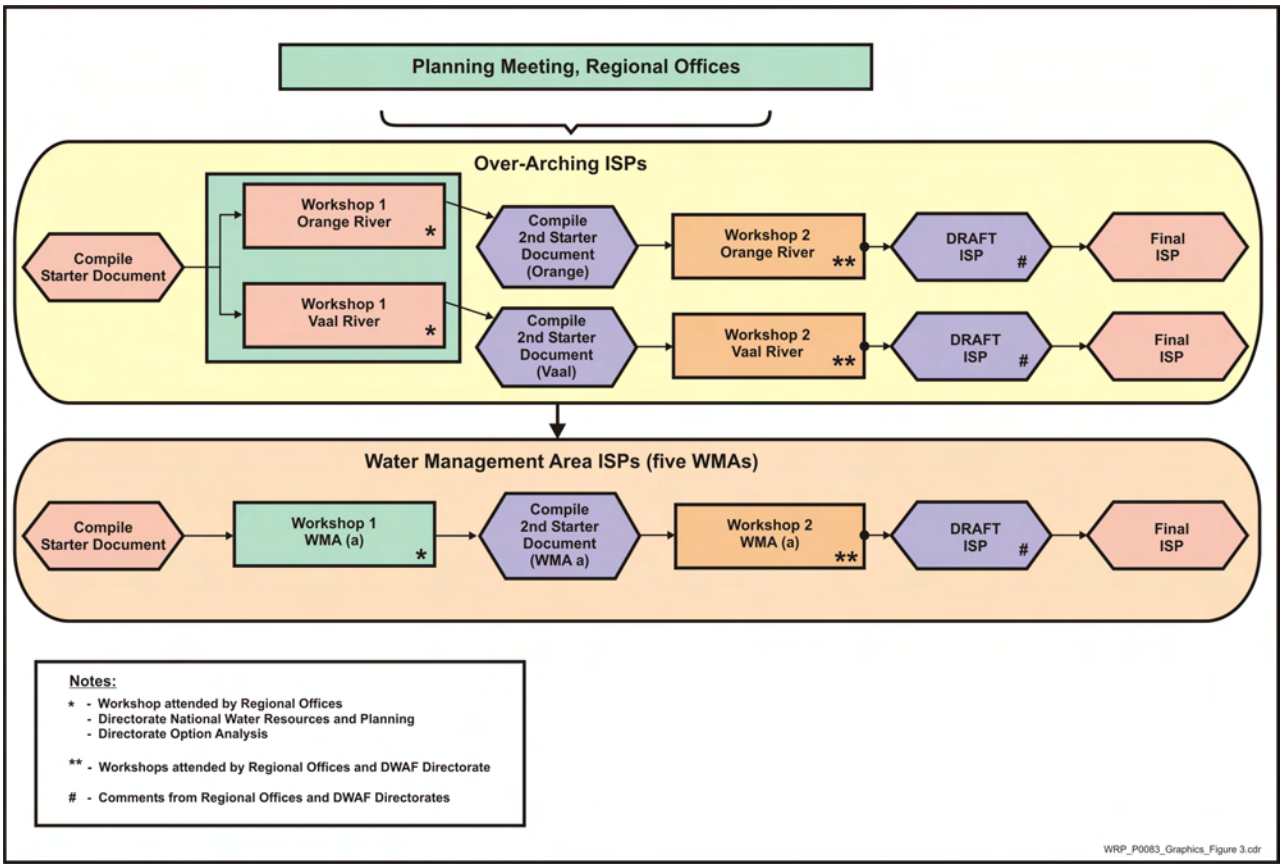

Figure 1.3 : Schematic showing ISP development process

The process for the development of the overarching and the individual ISPs for the Vaal River system is shown in **Figure 1.3**. The Overarching ISP for the Orange River was developed in five stages as follows:

i) Determining the current status of water resource management and relevant water resource management overarching issues and concerns in the Upper, Middel and Lower Vaal WMAs. This was achieved through interviews with individual members of DWAF's RO in Bloemfontein and Pretoria and by collating information from the NWRS, WMA reports, Water Resource Situation Assessment (WRSA) reports and other catchment study reports. The following topics were discussed with Regional Office staff and their issues and concerns documented:

- Water Situation.
- Resource Protection.
- Water Use.
- Water Reconciliation.

- Water Infrastructure.
- Monitoring and Information.
- Water Management Institutions.
- Co-operative Governance.
- Planning Responsibilities.

A starter document of the identified issues and concerns was produced as a discussion document for the first workshop.

ii) The first workshop was held with attendees from the Regional Office, the Integrated Water Resource Planning (IWRP) Chief Directorate of the Department as well as the consulting team. The workshop focussed on the lists of general issues in the WMA as well as area-specific issues. The issues were clarified and refined during the workshop. Strategies were discussed and developed to address the issues.

iii) The third stage involved the preparation of the second workshop document to be used for refining strategies to address the various issues and concerns, during the second workshop.

iv) The fourth stage was the second workshop. During this workshop the overall management of the water resources in the catchment was discussed along with the ISP management strategies and the relevant issues and concerns. The priorities and responsibilities for carrying out the strategies were identified. First workshop attendees were again involved, as were representatives of several DWAF Head Office directorates.

v) The fifth stage was the finalisation of the ISP document.

As can be deduced from the above this Vaal River Overarching ISP was prepared internally within the Department, and captures the Department's perspectives. Once approved by DWAF Management, it is intended that the Regional Office will make the ISP available to Water User Associations (WUAs), Water Service Providers (WSPs), Water Service Authorities (WSAs) and other forums for discussion and comment. These comments will be considered and worked into later versions of the ISP. By adopting this procedure this ISP becomes a working document, which will be progressively updated and revised by DWAF. Public participation forms part of the CMS process, for which the ISP serves as a foundation.

The ISP does not formulate all the details pertaining to every strategy but provides a suggested framework for each strategy around which the details will be developed by the responsible authority. Where relevant and readily available, certain details have been included in the strategies. The responsible authority for the further development of each strategy is indicated. This is predominantly the Regional Office, which remains responsible for involving the relevant DWAF directorates.

1.3.3 Limitations of the ISP

Although the ISP attempts to cover most aspects of Integrated Water Resource Management (as described in **Section 1.4**), there are certain limitations and aspects that are not dealt with in the document as indicated below:

- The ISP is not an operating manual for the Vaal River System but rather give strategic guidance on broad regulating principles. A series of Annual Operating Analysis reports published since 1989 provide information on how the system is operated. (**DWAF, 2004d**)

- Limited emphasis was given in the ISP on detailed institutional arrangements between existing (i.e. National Department and Cluster Management) and proposed regulating authorities (i.e. CMA and possible National Utility). These arrangements will however be an integral part of the process of implementing and establishing these institutions.

- The ISP views water resource management from a strategic perspective and leaves detail implementation and financial planning to be executed as part of the business planning and budgeting processes that are currently operational in the Department. (See "IMPLEMENTATION STRATEGY A.8" in **Appendix A** for details on the intended implementation of the ISP.)

1.3.4 Updating of the ISP Report

The ISP strategies should not lag behind national developments, become outdated or differ from related ISPs regarding trans-boundary management. There is therefore a need to have a standard process for updating strategies, and to prevent strategies becoming outdated by ensuring adequate feedback from national developments. Furthermore, the proposal and introduction of new strategies needs to be accommodated. It is suggested that each strategy has a version-control system. The following is necessary:

- Keep abreast of changes in national legislation and policy changes or refinements by keeping a list of all relevant legislation and supporting documents relevant to the ISP.

- Ensure consistency between the ISP strategies and national strategies through a regular review-and-update procedure.

- Annually review and ensure consistency and agreement regarding trans-boundary ISP management issues by liasing with the responsible managers of other areas and updating relevant ISP strategies if necessary.

- Annually review the priorities of required management actions and align budgets accordingly.

- Monitor the implementation of the ISP (review actions, progress, implementation and stumbling blocks).

- Incorporate feedback from stakeholders.

- Rigorously apply ISP version control.

Updating and Version Control

The actual frequency of ISP revision will be determined by the number and extent of revisions to management approaches as reflected in Strategy amendments. All updates to this report, particularly with respect to amendment to the Strategies, need to be passed on to and vetted by

the Catchment Manager for the Upper, Middle and Lower Vaal WMAs. The current incumbent is Ms T Malaka, who has been delegated the task of managing version control.

1.3.5 The Authority of Information Contained in the ISP

The NWRS is a statutory document, subject to a high level of public scrutiny and input, and signed off by the Minister. The information contained in the NWRS is the best information and knowledge available at the time. The information in **Chapter 2** and **Appendix D** of the NWRS Strategy on water requirements, availability and reconciliation was updated with comments received from the public participation process in the second half of 2002. To enable the finalisation of the NWRS, these figures were "closed" for changes in February 2003.

Underlying the figures in **Chapter 2** and **Appendix D** is a set of 19 reports "Overview of Water Resources Availability and Utilisation", one for each WMA. These reports contain more detailed information on each WMA than was summarised for the NWRS and are referred to, in short, as "WMA Reports". The WMA reports were also finalised with the February 2003 information.

Still deeper in the background lies another set of reports (one per WMA), the so-called Water Resource Situation Assessment Reports. These reports contain a wealth of information on each WMA, but the figures on requirements, availability and reconciliation have been superceded by the WMA report and the NWRS.

The ISPs for all WMAs used the information contained in the NWRS and WMA reports as the point of departure. However, an inevitable result of the ISP process has been that better information has emerged in some cases. The reason is that the level of study is more detailed and intense for the ISP. This included very close scrutiny of the numbers used in the NWRS, and in some cases a reworking of base data and some re-modelling. Where the ISPs contain yield balance data, which differs from the NWRS, these discrepancies are carefully explained. Where other differences from the NWRS are necessary these are also detailed in the ISP, with accompanying explanations.

It is required that the Department work with the best possible data so that the best possible decisions can be taken. Where the ISPs have improved upon the NWRS then this is the data that should be used. The new data contained in the ISP will also be open to public scrutiny as the ISP reports will be published on the Internet and in hardcopy, and will be presented and discussed at WMA forums. Comments received will be considered and worked into subsequent versions of the ISP on a regular (yearly) basis. The NWRS will be updated to reflect the latest understanding in each new edition.

1.4 INTEGRATED WATER RESOURCE MANAGEMENT (IWRM)

It is imperative that the natural, social, economic, political and other environments and their various components are adequately considered when conducting water resources planning and management. Water as a strategic component also interacts with other components in all environments. For example, human activities such as the use of land, the disposal of waste, and air pollution can have major impacts on the quantity and quality of water, which is available for human use and for proper life support to natural biota.

Taking an even broader view, water must also be managed in full understanding of its importance for social and economic development. It is important to ensure that there is

conformity between the water-related plans and programmes of the CMAs, and the plans and programmes of all other role players in their management areas. The CMAs must therefore establish co-operative relationships with a wide range of stakeholders, including other water management institutions, water services institutions, provincial and local government authorities, communities, water users ranging from large industries to individual irrigators, and other interested persons.

This integrated planning and management approach is intended, through co-operative governance and public participation, to enable water managers to meet the needs of all people for water, employment, and economic growth in a manner that also allows protection and, where necessary, rehabilitation of aquatic ecosystems. Above all, Integrated Water Resource Management (IWRM) will enable water managers to use our precious water resources to assist us in poverty eradication and removal of inequity.

One of the big opportunities to formally integrate a large number of actions in water resource management presents itself during the compulsory licensing process.

Compulsory licensing is identified in the NWRS as a very important action for implementing the NWA. However, it is not a simple action of issuing licences but a complex process of closely related and interdependent activities that will in itself formalise IWRM to a great extent. The process of IWRM is diagrammatically depicted in **Figure 1.4**.

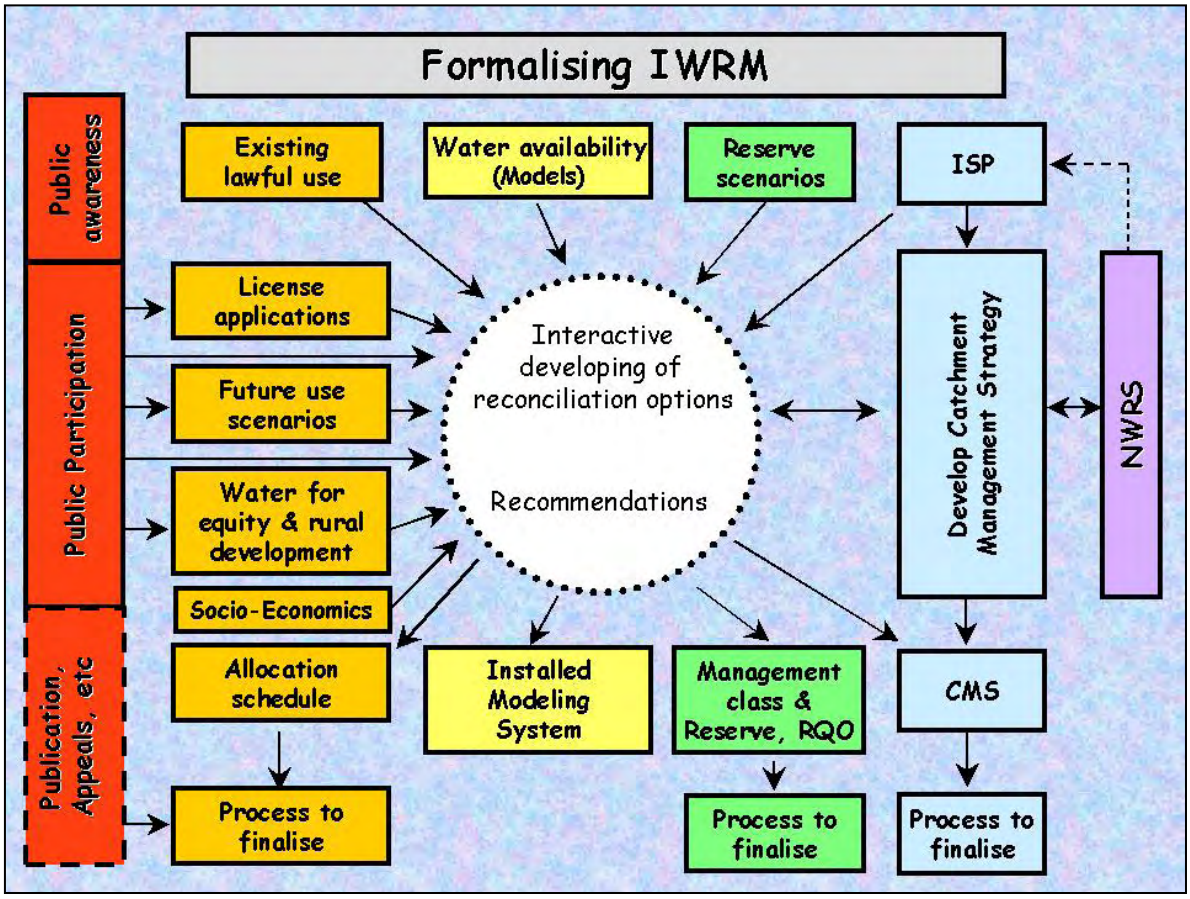

Figure 1.4: Diagram showing the Integrated Water Resources Management approach adopted by DWAF

Before an allocation schedule can be determined and the legal steps followed to finalise compulsory licensing (through the issuing of licences to all users), many other aspects must be addressed:

- Existing use and the lawfulness of that use must be verified, all users (existing and new) must apply for licences, a good understanding of future use scenarios must be developed and water required for equity purposes and rural development must be clearly understood.
- Water availability must be understood as thoroughly as possible with "best available" existing information used to model all possible reconciliation options.
- Reserve scenarios must be developed for all significant resources in the catchment, for instance, the river flow requirements for all possible classes that may be considered.
- The development of strategies for implementing the licensing (abstraction controls, for example), the Reserve and Resource Quality Objectives (i.e. incrementally over time) must go hand in hand with the rest of the processes to ensure that practical, workable solutions are found.

The processes will then enter a very intensive, interactive phase of developing realistic reconciliation options. This would entail, for example, the selection of a specific management class to be scrutinised for its impact on the number of licences that could be issued for use, with its concomitant impacts on the social and economic structure of the catchment.

The active participation of stakeholders in this process will then hopefully crystallise clear recommendations on an allocation schedule, management classes for the various reaches of the rivers and the resultant ecological Reserve and Resource Quality Objectives, as well as strategies for the implementation.

Although the Department will play a very strong role in guiding this process, it is extremely important to have the CMA actively involved. Preferably, at least the Board of the CMA must be in place to drive the public participation for the process.

It will be difficult to classify the rivers before this process, as the implications will be almost impossible to determine. Reserve determinations (regardless of how comprehensively they may have been done), will remain at the preliminary level until the classification is formalised in this process.

1.5 CARING FOR THE ENVIRONMENT

DWAF is responsible for water resource development and management in terms of the NWA, and within the broader framework of other environmental legislation. The Department also strongly reflects the will to make sound decisions which ensure the development of society and the economy whilst maintaining, and where possible enhancing, ecological integrity. The concept of management of the environment has evolved from the exclusivity of protection of plants and animals to balancing the complex interaction of society, the economy, and ecology. “Environmental management is the integration of social, economic and ecological factors into planning, implementation and decision-making so as to ensure that development serves present and future generations” (NEMA).

The key legislative Acts to which DWAF is required to refer are the National Environmental Management Act (NEMA, Act 107 of 1998) and the Environment Conservation Act (ECA, Act 73 of 1989). DWAF has prepared a Consolidated Environmental Implementation and Management Plan (CEIMP) as a requirement of NEMA. This describes the Department's functions, policies, plans and programmes, and states how these comply with environmental legislation. Through the CEIMP the Department has committed itself to developing and implementing an integrated Environmental Management Framework (EMF) to ensure that its approach is aligned with the principles prescribed in NEMA and the ECA. The EMF will inform the Department at a strategic decision-making level, bring about environmental legal compliance, and help in achieving environmental sustainability through the promotion of sound environmental management practices. Integrated Environmental Management is a co-operative governance effort with DWAF as a full partner in the process.

This ISP has the responsibility of raising and maintaining the environmental consciousness of the Department's water resource planners and managers. The control over water has a very broad range of influence and impact for which strategies and planning need to account. Impacts come from many different angles.

Some of these angles of impact which are considered through this ISP are noted below:

- The direct impact of physical structures (environmental constraints to construction e.g. of weirs or dams).
- The implications of allocating and licensing water for use. Forestry and irrigation are examples of users where development based on water can mean the transformation of extensive areas of otherwise 'natural' environments.
- The allocation of water for equity. Here we can include approaches towards the application of Schedule 1 Use, General Authorisations, the revitalisation of irrigation schemes, etc.
- Failure to support equity, or appropriate development – noting the consequential impacts of poverty.
- Sanitation systems and the impacts on groundwater quality.
- The implementation of the Reserve.
- The ability to monitor and manage compliance, thus protecting the resource and with it the environment.

All decisions regarding water are critical to the environment. Decisions must be made on a balance of social, economic and ecological costs and benefits, considering both the immediate and the long-term, and always with an eye out for the unintended consequence. It is the intention of the ISP to provide the basis for integrated decision-making. The principles of environmental management underpin every strategy developed in this document.

There are a number of strategic areas with a particularly strong biophysical/ ecological emphasis. These include:

- The Reserve (groundwater, rivers, wetlands and estuaries).

- Water quality - surface and groundwater.
- The approach towards the clearing of Invasive Alien Plants.
- The management of wetlands.
- Land degradation. Erosion and sedimentation (land care).
- Land use and especially how this is impacted by land reform and the re-allocation of water.

The roles of Co-operative Governance and the need for awareness raising and capacity building are key strategic elements of many strategies.

In reality all strategies and all aspects of management have a strong interaction with the biophysical environment. This ISP endeavours to capture all of these concerns in discussion and through a strategic approach, which emphasises the will of the Department to manage the environment to the best benefit of the country and its people.

The approach set out above applies to all Water Management Areas and associated ISPs, and is not repeated within the Strategy Tables (**Appendix A** of this ISP). It reflects the way the Department views Integrated Water Resource Management and the importance of the biophysical aspects of decision-making. There may nevertheless be specific ecological and biophysical aspects of management, which require specific attention and which may not be captured in the above-mentioned or other strategies. The ISP therefore still includes an Environmental Strategy, which serves to make pertinent those issues of the environment, which might not otherwise be covered.

1.6 THE SOCIAL ENVIRONMENT

The utilisation of water resources is aimed at the benefit of society, and at society through the economy. As noted in **Section 1.5** this should not be at undue cost to ecological integrity.

Impacts on society are a core element of this ISP, and decisions are often complicated by the risk of unintended consequence. As a typical example the over-zealous implementation of the ecological Reserve may benefit the river, to the intended benefit of society, but the cost of the lack of use of that water to employment and to livelihoods may lead to other strains on natural resources that undo the benefits.

The implementation of the NWA requires that society be kept at the forefront of all decision-making. This principle is now deep-seated within the Department and is integral to all strategies. Water resource allocation and use has critical social impact, as does water quality management. But pivotal to the social component is the question of equity. What can be done and what is being done to redress past inequities? Within this, strategies have been developed to consider the provision of water to Resource Poor Farmers, the use of water under Schedule 1, Licensing and General Authorisations, etc. Whilst water supply and sanitation are not part of the brief of the ISP, the provision of water to meet these needs most certainly is. The urban poor, and the poor in rural villages, are as important in the consideration of the distribution and use of water resources as are the rural subsistence poor, and this should not be forgotten in the urgencies of land reform and the enthusiasm to establish a substantial class of farmers from amongst the previously disadvantaged.

This ISP aims to see water benefiting society. This can be through access to water in livelihood strategies, through small-farmer development programmes, through water supply and sanitation and especially the provision of good quality drinking water, and through the maintenance and growth of income-producing, job creating, and tax paying agricultural, commercial and industrial strategies.

Consultation and public participation are cornerstones of the social component of any strategic document. These requirements are repeatedly stressed throughout the National Water Act. This ISP has been prepared as DWAF's position statement with respect to the management of water resources and, although strategies and plans have been captured without consultation with the stakeholders, it remains an open and transparent document where the understanding of the Department, its visions and its principles are made clear for all to see and to interact with. This is amplified in the "IMPLEMENTATION STRATEGY A.8" in **Appendix A** of this ISP.

1.7 WATER QUALITY MANAGEMENT

Much of the emphasis in water resource management has revolved around ensuring that users have sufficient quantities of water. However, as more water gets used and re-used, as quantities get scarce and feedback loops get even tighter, it is quality that begins to take on a dominant role.

Water availability is only as good as the quality of that water. Both quantity and quality need to be considered at the correct level of detail, and this can mean that at times they should be considered with similar emphasis and with similar expenditure of resources. Too often we have failed to integrate the issues of quantity and quality – both with regard to surface water and groundwater. The concept of Available Assimilative Capacity, the ability of the water resource to absorb a level of pollution and remain 'serviceable', is as important in water resource management as is the concept of Systems Yield.

Quantity and quality can no longer be managed in isolation of each other. Not that this isolation has ever been total. The importance of releasing better quality water from Gariep Dam for freshening the saline water Fish and Sundays rivers in the Eastern Cape, and of the addition of freshening releases from Vaal Barrage to bring water back to an acceptable quality has, inter alia, long been standard practice. The consequences of irrigation, the leaching of fertilisers, and more importantly the leaching of salts from deeper soil horizons can render both the lands themselves and the receiving rivers unsuitable for use. Diffuse agricultural 'effluent' may be less visible than direct discharges of sewage or industrial effluent, but are no less pernicious.

Direct discharges to rivers are licensed and managed on the basis of assimilative capacities of those rivers, and on Receiving Water Quality. Where these limits are exceeded, often through the cumulative impact of diffuse discharges, water becomes unavailable to some, or even all, users downstream. DWAF will licence users to take water, and again to discharge it in recognition that there is generally a cost to the resource in terms of a reduction in quality and a reduction in its further assimilative capacity. It is for this reason, and in order to bring about additional management and a strong incentive, that the Waste Discharge Charge System is being developed. Discharge users will be obliged to pay, depending on the quantity and quality of their discharge.

Surface water quality is affected by many things including sediment and erosion, the diffuse discharges from irrigated farmland (both fertilisers and salinity through leaching), domestic and urban runoff, industrial waste, and sewage discharges. Of these, industrial waste and sewage discharges are the easiest to licence and control, but this does not mean that this is problem-free. The Department has found that the situation with regard to sewage discharges often far exceeds the standards and conditions demanded by licences. There is a problem of compliance with regard to Local Authorities and private operators responsible for waste management systems. Diffuse discharges only compound the problem by reducing the assimilative capacity until the water becomes unfit for use, very expensive to purify, and a danger to human health.

Groundwater quality requires equal attention, and more so as we recognise the importance of groundwater in supplementing our meagre resources, and providing water to remote communities. Although our groundwater resources are for the most part to be found at a relatively deep level (50-100m is quite typical) this water can easily be polluted by surface activity. The leaching of fertilisers is one such problem but of greater concern is the influx of nitrates, primarily a consequence of human habitation and sanitation. Pit latrines are on the one hand so necessary, and have the huge advantage of not requiring volumes of water, but disposal is 'on-site', and often responsible for the longer-term pollution of the underlying aquifers which feed and water the communities above.

Water quality is a very important aspect of strategy within this ISP – considered primarily within the Water Quality Strategy and also under Groundwater. Industrial wastewater discharge, diffuse agricultural discharges, wastewater treatment works, the location and management of solid waste disposal sites, the siting of new developments, informal settlements and the impacts of sanitation systems, are all elements considered with great concern in this and other ISPs. Despite this attention it may be that Water Quality has still not taken its rightful place in the integrated management of the water resource. But the Department is moving towards IWRM and the integration of quantity and quality issues. Managers have now been given crosscutting responsibilities that will ensure a far more integrated approach in future.

Actions recommended within the Department include:

- The need to actively workshop the integration process. Resource Management, Planning and Allocations of Groundwater and Surface Water Quantity and Quality.
- The review and incorporation of knowledge from recent Water Research Commission Studies on both radioactivity and nitrates (groundwater quality issues).
- A review of all water quality literature reflecting situational knowledge and understanding within this WMA (and each and every WMA).
- Ensure that Water Quality monitoring is fully integrated into WMA water resources monitoring.

Refer particularly to the strategy on "WATER QUALITY MANAGEMENT A.2.2" and the "MONITORING AND INFORMATION MANAGEMENT STRATEGY A.7**"** in **Appendix A** of this ISP.

1.8 GROUNDWATER

The ISP process in all of the Water Management Areas of South Africa has highlighted the role and importance of groundwater as part of the total water resource. Although groundwater has always been important in some areas this overall vision is a significant advance on our previous understanding of the potential for groundwater use. With the surface water resources in many WMAs now fully utilised, almost the only opportunity left for further development lies in the exploitation of groundwater. More particularly it is recognised that many of the more remote towns and villages, far from surface supplies, can in fact supply or supplement existing sources through groundwater, and that this must become a priority option. So, too, many small communities and subsistence farmers can avail themselves of groundwater when it would otherwise be impossible or impractical to lay on piped supplies. This can also reduce the pressure on existing users and perhaps even circumvent the need for Compulsory Licensing. The Department will be developing its capacity to explore and encourage the use of groundwater.

Of obvious concern is the likelihood of an interaction between groundwater and surface water. If the interaction is strong then additional use of groundwater may simply be reducing the surface water resource already allocated to someone else. In some instances (such as in the case of dolomitic aquifers) this interaction can indeed be very strong, whilst across many areas of the country it is so weak as to be negligible. In these circumstances groundwater comprises a huge pool of available water, which is only of benefit if it is utilised. Care must always be taken with the issuing of licenses to ensure that both the Groundwater Reserve and other downstream users do not end up being the losers.

The realisation in this and other ISPs is that groundwater offers a huge resource of water, which can be tapped, and that this can be a very significant supplement to the national water resource.

1.9 PUBLIC RECREATION - THE USE OF DAMS AND RIVERS

The use of water for recreational purposes is one of the 11 water uses regulated in terms of the NWA (**Section 21 j**). The Department is developing a national policy towards 'Recreation on Dams and Rivers' and this should, in the first instance, be adhered to. Recreational use can take many forms and only occasionally has any direct impact on the water resource. Most obvious are activities such as power-boating, sailing and swimming which can have quality / pollution impacts. Far more significant in terms of both quantity and quality is the release of water to allow for canoeing and other water sports downstream (The Upper Vaal, Dusi and Fish River canoe marathons being prime examples). These activities can bring very significant economic benefits to the WMAs concerned, and where water releases can be accommodated, particularly through alignment with the needs of the ecological Reserve or other downstream users, then so much the better.

It is noted in this ISP that water resources offer a very significant recreational outlet and that recreation is an important public and social asset necessary for national health and productivity. A central philosophy is that recreational opportunity should not be unreasonably and unnecessarily denied to users, and that the implementation of policy should ensure that disadvantaged and poor people should also be able to avail themselves of opportunities.

The Department has already transferred responsibility for the management of many public waters to Local Authorities and will continue with this process. Responsibility will therefore devolve upon these Authorities, but within the broad principles as laid down by the Department.

1.10 CO-OPERATIVE GOVERNANCE – THE PLACE OF THE ISP

The ISP is DWAF's approach to the management of water resources within the WMA. This will, in the longer term, be replaced by a fully consultative Catchment Management Agency. What is most important, in the medium term is that the ISP has a good fit with the Provincial Growth and Development Plan, with regional and other Environmental Management Plans, with plans and expectations of the Departments of Agriculture, Land Affairs, the Environment and others. It must also be aligned with the Integrated Development Plans and Water Services Development Plans now required for each District Municipality. Water is very often a constraining feature in development and co-operative governance planning and implementation is essential in matching what is wanted with what is possible.

The implementation of the overarching ISP is expected to take place through the Central Cluster (Cluster Manager) as more than one WMA are included in the area under consideration. The Central Cluster incorporates the Regional Offices of 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.

CHAPTER 2: PERSPECTIVE ON THE WATER SITUATION IN THE VAAL RIVER SYSTEM AND STRATEGIES FOR WATER RESOURCE MANAGEMENT

2.1 INTRODUCTION

The Water Resources of the Vaal River System is an important asset to the country and it's people, supporting major economic activities and a population of about 12 million people. The boundaries of the Vaal River System, for the purpose of this document, include three water management areas (WMAs) namely the Upper Vaal, Middle Vaal and Lower Vaal. Due to the cascading orientation and the associated inter-dependency of the three water management areas, it is essential that the water resources of the Vaal River System are managed to achieve a balance in meeting specific requirements in each WMA as well as fulfilling the transfer obligations between the WMAs. The layout of the three Vaal and two Orange water management areas are presented geographically in **Figure B-1** of **Appendix B**.

The extent of the water resource infrastructure in the Vaal River System is best presented schematically, as shown in the figure in **Figure B-2** of **Appendix B**. The schematic shows the full extent of the *Integrated* Vaal River System which consists of the Vaal River System and other water resource systems (located in adjacent WMAs) that are linked to the Vaal River System. Also shown is the main infrastructure that is associated with the Upper Vaal, Middle Vaal and Lower Vaal WMAs. An important characteristic of the water resource is that substantial transfers occur from the Thukela River, the Usutu River and Senqu River (in Lesotho) into the Vaal River System. The Vaal River serves as conduit to transfer water among the three Vaal WMAs and significant transfers out of the Upper Vaal WMA occur through the distribution system of Rand Water to the Crocodile West and Marico WMA. (More detail on the transfers in and out of the three Vaal WMAs are presented respectively in **Sections 2.2, 2.3** and **2.4**)

The Upper Vaal WMA is highly developed, with major urban and mining land use activities contributing more than three times that of the Gross Domestic Product (GDP) of the other two Vaal WMA combined. These activities have significantly impacted on the quality of the water resources, and diligent management practices are necessary to ensure water of acceptable quality is available to users in the system. It is further expected that the land use will continue to grow in future, demanding even more intensive management interventions.

These main characteristics of the Vaal River System point to the need for water resources management activities that cut across WMA boundaries in order to achieve optimum solutions for issues that relate to the interdependency of the linked water resource systems.

Information on the water resource situation in the Vaal River System is available in reports from the many studies and investigations which the Department of Water Affairs and Forestry (DWAF) has commissioned over time. Of those the most recent publications, which serve as sources of information for this chapter, are the National Water Resources Strategy (NWRS), the supporting reports for each WMA with the common title "*Overview of the Water Resources Availability and Utilisation*", the Water Resource Situation Assessment Studies (WRSAS), and other technical reports.

General descriptions of the three Vaal WMAs are presented in **Sections 2.2, 2.3** and **2.4** which is followed by **Sections 2.5, 2.6** and **2.7**, presenting respectively the water resource availability, water requirements and water balance of the Vaal River System. Options for reconciling the water requirements with the availability are provided in **Section 2.8,** including discussions on allocation of available water and the necessity for Compulsory Licensing. **Section 2.9** gives the broad perspective on water quality management in the system, with the remaining sections, in **Chapter 2**, describing the main aspects regarding institutional issues, water infrastructure management, information management and finally the implementation of the ISP.

2.2 OVERVIEW OF THE UPPER VAAL WATER MANAGEMENT AREA

The location and general layout of the WMA is given in **Figure 2.1**. The Upper Vaal WMA covers part of four provinces viz. Gauteng, Free State, Mpumulanga, and North West provinces. The major rivers in the WMA are the Vaal and its tributary the Wilge River. Other significant tributaries are the Klip (Free State), Liebenbergsvlei, Waterval, Suikerbosrand, Klip (Gauteng) and Mooi Rivers.

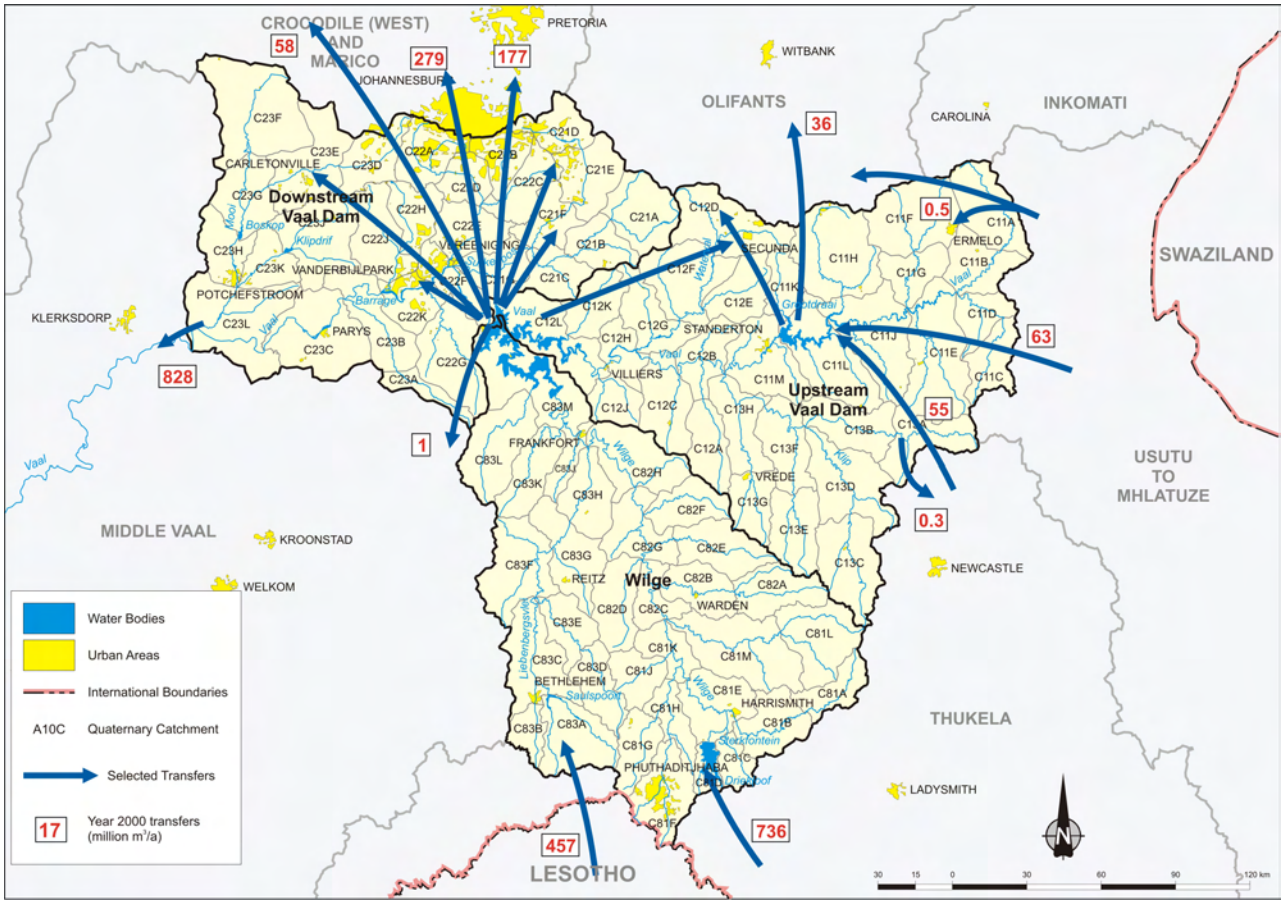

Figure 2.1 : Layout and location of the Upper Vaal WMA (DWAF, 2003a)

2.2.1 Physical Characteristics

The climate over the WMA is temperate and uniform. The rainfall is strongly seasonal with the rainfall occurring during the summer. The mean annual precipitation (MAP) decreases from 800 mm in the south east to 600 mm in the north west with the potential evaporation increasing from 1300 mm in the south east to 1700 mm in the north west. Vegetation is mostly savannah grassland with sparse bushveld. The geology is varied and is particularly complex in the west

and north-west where the mineral deposits are found. Extensive dolomitic formations also occur in this part.

2.2.2 Land Use, Economic and Development Characteristics

Land use in the catchment is characterised by the sprawling urban and industrial areas in the northern and western parts. Most mining is also located in these areas although much of this is now inactive. Maize, wheat and other annual crops are grown on large areas under dry land cultivation in the central and south western parts. There are several large towns in the WMA, mainly to serve the mining and agricultural development.

The Upper Vaal WMA does not directly share any rivers with neighbouring countries. Large quantities of water are, however, transferred into the WMA from Lesotho and through inter catchment transfers to and from neighbouring WMAs. The transfer of water from Lesotho is done in accordance with a Treaty between South Africa and Lesotho. Through the inter-catchment transfers and the control of releases along the Vaal River, water management in the Upper Vaal WMA eventually impacts on all South Africa's neighbours.

Nearly 20% of the GDP of South Africa originates from the Upper Vaal WMA. This is the second largest contribution to the national wealth amongst all the WMAs. The manufacturing sector contributes over 30% to the Gross Geographic Product (GGP) generated in the WMA, followed by trade at just over 15% and both finance and mining slightly higher thatn 10%. Despite the large areas under cultivation, agriculture only contributes about 2% of the GGP. It nevertheless has important linkages to other sectors and provides livelihood to a large proportion of the rural population.

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. New gold mining developments will be replacing worked out mines, although a general long term decline is expected. Large coal reserves are present in the WMA and it is expected that the exploitation of these resources will occur over the medium to long term.

2.3 OVERVIEW OF THE MIDDLE VAAL WATER MANAGEMENT AREA

The Middle Vaal WMA is situated in the central part of South Africa, in the Free State and North West Provinces. The WMA lies between the Upper and Lower Vaal WMAs and borders on the Crocodile West, Marico and the Upper Orange WMAs. The main tributaries are the Skoonspruit, Rhenoster, Vals and Vet rivers.

2.3.1 Physical Characteristics

The climate is semi-arid with the MAP declining from 700 mm in the East to 500 mm in the West and a potential evaporation increasing from 1400 mm in the East to 1900 mm in the West. The vegetation is mainly grassland with sparse bushveld in patches. The topography is relatively flat with no distinct features. The geology is varied with a large dolomitic intrusion occurring in the Orkney area of the WMA. Diamonds are found in the north east of the WMA, with rich gold ore in the vicinity of Klerksdorp and Welkom. The location and general layout of the WMA is shown in **Figure 2.2.**

Figure 2.2 : General layout and location of Middle Vaal WMA (DWAF, 2003b)

2.3.2 Land Use, Economic and Development Characteristics

The land use in this area is 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 at Klerksdorp, Welkom and Kroonstad. Numerous inactive mines are found in the north and west of the WMA, many of which were small diamond claims.

The Middle Vaal WMA neither adjoins nor shares any rivers with any neighbouring countries and therefore has no international obligations to satisfy.

The economy of the Middle Vaal WMA contributes about 4% of the GDP of South Africa. The most dominant economic activity is the mining sector, generating more than 45% of the GGP in the WMA.

The dominant mining activity in the area is gold mining. 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 gold price, exchange rate, operating costs, tax regime and environmental requirements. The declining trend is however expected to continue. The agricultural sector is stable and is expected to continue making an important contribution to the economy of the WMA.

2.4 OVERVIEW OF THE LOWER VAAL WATER MANAGEMENT AREA

2.4.1 Physical Characteristics

The Lower Vaal WMA lies across the North West, Northern Cape and Free State provinces. The WMA borders on Botswana in the North. In the south east the Vaal River is the only main river and the Harts River the only significant tributary. The largest (north west) part of the WMA falls within the catchment of the Molopo River, which is a tributary of the Orange River. This river is however endoreic and water may only reach the Orange only under exceptionally high rainfall conditions. There are no distinct topographic features in the WMA with most of the terrain being relatively flat. The MAP declines from 500 mm in the east to 100 mm in the west with a potential evaporation reaching as high as 2800 mm/a. The location and layout of the WMA is given in **Figure 2.3**.

2.4.2 Land Use, Economic and Development Characteristics

The land use in the area 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 and alluvial diamonds are found near Bloemhof. Iron ore and other minerals are found in the south-eastern parts of the WMA. Kimberley is the only significant urban area.

Figure 2.3 : General layout and location of Lower Vaal WMA (DWAF, 2003c)

The Molopo River forms the border between South Africa and Botswana. Utilisation of this shared resource by the two countries is regulated by the Joint Permanent Technical Committee. The Lower Vaal WMA also falls within the Orange River basin, which is shared by South Africa, Lesotho, Botswana and Namibia. Co-operation amongst the Orange River basin countries is facilitated by the Orange-Senqu River Commission. There is also a need for the better management of trans border groundwater aquifers shared by South Africa and Botswana.

The economy of the WMA is relatively small and contributes less than 2% of the GDP of South Africa. Mining and agriculture are the main primary production activities in the WMA.

2.5 WATER AVAILABILITY AND RESOURCE EXTENT

The surface water availability in the Integrated 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, determined the need for restrictions during drought periods and 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.

Due to the intensity of the hydrological study that produced the hydrology data for the water resource models, it can be stated that the water resource availability estimates for the large water resource system carry a high level of confidence. It is however important to note that the focus of the hydrological study was on the main stem of the Vaal River and that the networks of the tributary catchments were configured in limited detail. To analyse and resolve water balance problems at tributary catchment scale, it will therefore be required to increase the model resolution. The catchment where refined models are required was identified and included in the WMA specific ISPs reports.

Summarising the water resource availability of the Vaal River System, which has multiple abstraction points that are supported by various tributary and incremental catchments, requires considerable simplification of the analysis results that are obtained from the more complex models that are referred to above. This was undertaken as part of the compilation of the NWRS and the reader is referred to the series of reports "Overview of the Water Resources Availability and Utilisation" (**DWAF, 2003a, b and c**) for each of the three Vaal WMAs. Further details are provided in the "RESOURCE AVAILABILITY A.1.1" strategy presented in **Appendix A**. The water resources availability information from these reports was used to compile the water balance presented in **Section 2.7** in this report.

2.6 WATER REQUIREMENTS

Reliable data on requirements (current use and future scenarios) have to be available to undertake water resource operational and development planning activities. The water requirement scenarios that are currently used for planning originate from the development of the National Water Resources Strategy (NWRS). The scenario generation methodology made use of driver variables such as population growth as impacted on by HIV/AIDS, migratory patterns based on social economic factors, and economic growth for over 700 consumption centres in the country.

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 verified use once the verification process is completed. (See Strategy "WATER REQUIREMENTS A.1.2**"** in **Appendix A** for the proposed management action)

Once a year the recorded water uses are compared to the scenarios and adjustments are made to the short-term projected values where appropriate. In addition, 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 for scenario analysis. Current data (March 2003) indicates that the water requirements for Eskom and Sasol are exceeding the scenarios used in previous planning studies (including the NWRS) and will bring the augmentation date of the Eastern Sub-system of the Vaal River System forward. (See the "WATER REQUIREMENTSA.1.2" strategy in **Appendix A** for details and proposed actions).

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.

2.7 WATER BALANCE

The water balance calculations presented in this report are based on a yield balance that is derived for a 1:50 year return period assurance level. This implies that the 1:50 year assured yields of the water resources are compared to water requirements that are converted (where appropriate) to an equivalent volume that have to be supplied at a reliability of 1:50 years.

The water balance of the Vaal River System is presented as a series of tables for each of the three Vaal WMA and considering the years 2000 and 2025 development levels. This information were obtained directly from the three Vaal WMA reports with the generic title "*Overview of the Water Resources Availability and Utilisation*" (**DWAF, 2003a, b & c**).

Due to the cascading layout of the three WMAs, the water balance connection or link between the WMAs is such that water shortages in a WMA can only be allocated in an upstream direction. It was therefore decided to present the balance results in the order: Lower Vaal, Middle Vaal and Upper Vaal. This is also the sequence in which the calculations are carried out, i.e. the main stem shortage in the down stream WMA is determined first, and then imposed as a transfer out of the immediate upstream WMA. The outcome of this balance calculation procedure for the three WMAs is that the overall water balance for the Vaal River System is reflected by the water balance of the Upper Vaal WMA. A surplus in the Upper Vaal WMA is therefore available for all three WMAs, along the main stem of the Vaal River.

In this document the water balance is viewed from an overarching perspective with the main focus on the water balance of the main stem of the Vaal River. Strategies regarding the surpluses and negative balances in the Sub-areas are dealt with in the WMA ISP specific documents and the reader is referred to those reports for further information on the sub-areas.

2.7.1 Water Balance for the year 2000

Table 2.1 below shows an overall surplus in the WMA of 30 million m^3/annum, which exist due to the return flows of 45 million m^3/annum from the Vaal Harts irrigation scheme. (see **Figure 2.3**) that is not fully utilised in the Vaal downstream of Bloemhof Sub-area. The transfer from the Middle Vaal WMA of 500 million m^3/annum is contained in the 545 million m^3/annum transfer into the Vaal downstream of Bloemhof Sub-area.

Table 2.1: Lower Vaal WMA: Reconciliation of requirements and available water for year 2000 (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Local yield	Transfers in (2)	Total	Local require-ments	Transfers out (2)	Total	(1)
Harts	136	419	555	494	45	539	16
Vaal downstream of Bloemhof	(46)	545	499	65	423	488	11
Molopo	35	4	39	36	0	36	3
Total	125	500	625	595	0	595	30

1) Brackets around numbers indicate negative balance. Surpluses are shown in the most upstream sub-area where they first become available.

2) *Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA.*

Changes made to the reconciliation balances for the year 2000

The following changes were made to derive the water balances that are presented in **Table 2.1**. The original balances were obtained from the "*Overview of the Water Resources Availability and Utilisation*" report for the Lower Vaal WMA (**DWAF, 2003c**).

Change 1: Due to the revised boundaries of the Lower Vaal WMA the water balance of the Vaal downstream of Bloemhof sub-area were changed by reducing both the "Transfers-in" and the "Local requirements" by 48 million m^3/annum.

Change 2: The transfer out of the Harts Sub-area to the Vaal downstream of Bloemhof sub-area was reduced from 62 million m^3/annum to 45 million m^3/annum. This change is due to an over estimation of the contribution of the return flows from the Vaalharts Irrigation Scheme to the system yield.

Description	Available water			Water requirements			Balance
	Local yield	Transfers in (2)	Total	Local require-ments	Transfers out (2)	Total	(1)
Changes affecting the Vaal downstream of Bloemhof sub-area:							
Figures given in the DWAF, 2003c	(46)	610	564	113	423	536	28
Change 1	-	-48	-48	-48	-	-48	-
Revised figures (Change 1)	(46)	562	516	65	423	488	28
Change 2	-	-17	-17	-	-	-	-17
Revised figures (Change 1&2)	(46)	545	499	65	423	488	11
Changes affecting the Harts sub-area:							
Figures given in the DWAF, 2003c	136	419	555	494	62	556	(1)
Change 2	-			-	-17	-17	17
Revised figures (Change 2)	136	419	555	494	45	539	16

For the Middle Vaal WMA balance, shown in **Table 2.2,** the 500 million m^3/annum transfer to the Lower Vaal WMA is included in the 559 million m^3/annum transferred out of the Middle Vaal Sub-area. In turn the support from the Upper Vaal WMA of 828 million m^3/annum to the Middle Vaal WMA is the main transfer into the Middle Vaal Sub-area. The approximate balance for the Middle Vaal sub-area is attributable to the fact that just enough water is released from the Upper Vaal water management area to ensure that the requirements in the Middle Vaal (and Lower Vaal) water management areas can be met.

Table 2.2: Middle Vaal WMA: Reconciliation of requirements and available water for year 2000 (million m³/a) - (DWAF, 2003b)

Sub-area	Available water			Water requirements			Balance
	Local Yield	Transfers in (2)	Total	Local require-ments	Transfers out (2)	Total	(1)
Rhenoster-Vals	44	1	45	54	0	54	(9)
Middle Vaal	(142)	828	686	129	559	688	(2)
Sand-Vet	147	59	206	187	2	189	17
Total	49	829	878	370	502	872	6

1) Brackets around numbers indicate negative balance. Surpluses are shown in the most upstream sub-area where they first become available.

2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA.

Finally, the overall water balance of the Upper Vaal WMA and the Vaal River System is presented in **Table 2.3,** which shows a surplus of 19 million m^3/annum.

Table 2.3: Upper Vaal WMA: Reconciliation of requirements and available water for year 2000 (million m³/a) - (DWAF, 2003a)

Sub-area	Available water			Water requirements			Balance
	Local yield	Transfers in (2)	Total	Local require-ments	Transfers out (2)	Total	(1)
Wilge	59	0	59	60	0	60	(1)
Upstream of Vaal Dam	184	118	302	216	67	283	19
Downstream of Vaal Dam	889	1 224	2 113	769	1 343(3)	2 112	1
Total	1 132	1 311	2 443	1 045	1 379	2 424	19

1) Brackets around numbers indicate negative balance. Surpluses are shown in the most upstream sub-area where they first become available.

2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA.

3) The transfer out of the Downstream of Vaal Dam Sub-area contains the transfer of 828 million m^3/annum to the Middle Vaal WMA.

Water Balance Qualifications:

- The surplus in the Upstream of Vaal Dam Sub-area is fully committed to support the projected growth in the water requirements of the existing users mainly Sasol and the Eskom power stations that are supplied from Grootdraai Dam. Furthermore, detailed system analysis results indicated that Grootdraai Dam and the sub-systems linked to it will require augmentation by the year 2010 or even earlier.

- The water balance presented in **Table 2.3** excludes the contribution of Phase 1b of the Lesotho Highlands Water Project (LHWP). Phase 1b consists of Mohle Dam, Matsoku Weir, and transfer tunnels to deliver additional water into Katse Dam from where it is transferred to the Upper Vaal WMA. This transfer scheme is to be commissioned towards the end of the year 2003 and will contribute an additional 320 million m^3/annum (after allowances for transfer losses) to the surplus presented in **Table 2.3**.

- The indicated surplus assumes that all the conduits transferring water into the Upper Vaal WMA is operated at full capacity. It will however be possible to manage the quantity of the surplus by controlling the volumes being transferred. This is especially the case where water is pumped as is for the Thukela-Vaal transfer scheme.

2.7.2 Projected Water Balance for the year 2025

Given that the water requirements in the Lower and Middle Vaal WMAs is not expected to increase significantly for the base scenario (See **DWAF,2003a** for a description), only the Upper Vaal WMA balance results are presented in this section for the year 2025 as shown in **Table** 2.4. The transfer to the Middle Vaal WMA of 837 million m^3/annum is reflected in the 1 561 million m^3/annum and represent a small increase from 828 million m^3/annum in the year 2000. These balance figures include the contribution from Phase 1b of the LHWP as indicated in note (4) below the table.

The projected shortfall of 44 million m^3/annum for the Vaal River System indicates that intervention will be required close to the year 2025.

Table 2.4 : Upper Vaal WMA: Reconciliation of water requirements and availability for the year 2025 base scenario (million m^3/a) – (DWAF, 2003a)

Sub-area	Available water			Water requirements			Balance
	Local yield (1)	Transfers In	Total	Local require-ments (2)	Transfers out	Total	(3)
Wilge	58	0	58	56	0	56	2
Upstream of Vaal Dam	184	118	302	256	74	330	(28)
Downstream of Vaal Dam	987	1 513(4)	2 500	957	1 561	2 518	(18)
Total	1 229	1 630	2 859	1 269	1 634	2 903	(44)

1) Based on existing infrastructure and under construction in the year 2000. Also includes return flows resulting from growth in requirements.

2) Based on normal growth in water requirements as a result of population growth and general economic development. Assumed no general increase in irrigation.

3) Brackets around numbers indicate negative balance.

4) Includes the yield contribution of 320 million m^3/annum (after allowances for transfer losses) from Phase 1b of the LHWP.

2.8 WATER BALANCE RECONCILIATION OPTIONS

Given the surplus of 19 million m^3/annum in the year 2000 and the additional contribution from Phase 1b of the LHWP (to commence delivery in the latter part of 2003) it is estimated that a **conditional surplus** of about 300 million m^3/a exists in the Vaal River System. The available surplus 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. The quantity transferred (and the pumping costs) will thus increase over time to match the growth in the water requirements.

With respect to the projected water balance, considering the growth in water requirements that are estimated for the near future, analysis shows that the balance will be positive until close to 2025 (see **Table 2.4** above). However, although this holds true for the system as a whole, the Eastern Sub-system, consisting of Grootdraai Dam and supporting systems, will need augmentation by about 2010 as indicated in the following sections.

2.8.1 Reconciliation of the Eastern Sub-system

A pre-feasibility study to determine the need for augmentation of the Eastern Sub-system has been completed and it was found that even with water conservation and demand management measures in place, additional water resources have to be developed to be able to supply the growth in demand that is projected for the year 2030. Several augmentation options have been identified, including a dam and pipeline on the Klip River (Free State), pipeline from Vaal Dam, Vaderlands Dam in the Pongola River and Merikloof Dam in the Usutu River. Further planning actions are needed to select the most feasible supply option for implementation.

New revised water requirement scenarios (March 2003) were obtained from Eskom and Sasol early in 2003, which gives higher projected demands compared to the previous estimates that was used in the abovementioned pre-feasibility study. The implication thereof is that augmentation is already required in 2007. This places a very high priority on the design and implementation of the augmentation scheme to support the Eastern Subsystem.

[*NOTE: Subsequent to the ISP workshops, Eskom indicated that in order to minimise the total risk of water supply, the pipeline option to transfer water from Vaal Dam would be the preferred scheme to augment the Eastern Subsystem. The Vaal Dam pipeline option has the advantage that water can be accessed from both the Thukela River and Lesotho Highlands rivers, which decreases the vulnerability with respect to localised droughts in the catchments of the Eastern Sub-system. DWAF therefore accepted that the pipeline option is the preferred option and further planning, design and implementation activities has commenced.]*

A further perspective on augmenting the supply to the Eastern Sub-system is the possibility that severe drought conditions over the short term, before the proposed pipeline is completed, may require emergency intervention in the form of constructing the Vaal Dam to Grootdraai Dam weir transfer scheme as a temporary measure. The decision to implement such a scheme will,

however, be delayed as late as possible to allow the maximum opportunity for recovery from the drought that will allow time for the completion of the proposed pipeline.

2.8.2 Reconciliation of the Vaal River System as a whole

a. Water Conservation and Demand Management

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 augmentation would be required (i.e. delay the date from 2025 to say 2030 or beyond). Therefore, with reference to the details provided in the "WATER CONSERVATION AND DEMAND MANAGEMENT STRATEGY A.4", it is essential to commission a WCDM study of the supply area of the Vaal River System with the aim to obtain a system wide plan of how WCDM will be implemented and what the impacts will be. The key to such a study will lie in collating information from the water users on planned WCDM measures and compile scenarios of water requirement and return flow for planning purposes.

Although a conditional surplus exists in the Vaal River System, benefits, other than postponing the next augmentation, provide sufficient motivation to continue with the implementation of WCDM measures over the short and medium term. There are numerous WCDM measures being implemented by Local Authorities and Service Providers, however, information regarding the effect these measures have on the Vaal River System demands is not readily available and will have to be obtained as part of the abovementioned study.

Due to the nature of the Vaal River System, return flows generated from the urban areas are indirectly used in the downstream portion of the system, with the result that WCDM measures that reduce return flows do not benefit the overall water balance of the system to the full extent of the water 'saved'. A further important aspect to consider when planning WCDM measures is the impact on water use charges with respect to the redemption of the capital invested in existing water supply infrastructure.

b. Water Resource Development Options

Various schemes to augment the supply of the Vaal River System (as a whole) have also been assessed and the most likely options are either the Thukela Water Project or a further phase of Lesotho Highlands Project. Although the required date of augmentation is far into the future it should be recognised that these schemes are capital intensive and require long lead times for implementation.

c. Perspective on the Ecological Reserve

The water balance presented above makes allowances for the Ecological Reserve using low confidence Desk Top estimates for the purpose of developing the National Water Resources Strategy (NWRS). Subsequent to the publication of the NWRS, a cursory assessment indicated that the positive water balance could decrease by as much as 300 million m^3/annum when using the flow requirements derived as part of the Vaal River System Analysis Update Study, also referred to as a Flow Management Plan for the Vaal River. Although no urgent Reserve issues were identified during the Overarching Workshops, the above factors point to the need for careful planning and implementation of the Ecological Reserve to balance, among

other things, the economic consequences and ecological benefits. Due to the interdependencies of the tributaries with the main stem of the Vaal River, it will be required to undertake the determination of the Reserve in an integrated way, balancing tributary contributions with the flow requirements of the main stem. (See the strategy on "RESERVE AND RESOURCE QUALITY OBJECTIVES A.2.1" for further details.)

d. Combined impacts – WCDM and Reserve implementation

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 occur with the savings from implementing WCDM measures. The first step towards such a strategy would be to obtain reliable planning information on both WCDM and the Reserve, so that sound motivations and informed decisions can be taken on the way forward.

2.8.3 Allocation of conditional surplus and licensing

Surpluses available in the Upper Vaal WMA (see **Section 2.7)** will also be available to the Middel and Lower Vaal WMAs and the allocation of the conditional surplus will be made at the National Level through the licensing process.

The allocation of the conditional surplus to new water abstraction users needs careful consideration. The applicants will have to prove efficient use through implementation or planned implementation of WCDM measures and consider local as well as system wide impacts on existing users both in terms of availability and water quality. Trading of water rights could also be considered in accordance with the National Trading Policy and guidelines.

Any new allocations from the system will carry the full Vaal River tariff on either the full allocation (if abstracted from the main stem or tributary carrying transfers) or the impact the abstraction will have on the yield of the system (if abstracted from any other tributary). The motivation for implementing the full cost is due to the fact that the surplus is only available under the condition that transfers occur from supporting systems. All water use charges are thoroughly described and will be implemented in accordance with the National Pricing Strategy.

It is the Departments view that the above strategy will go a long way to achieve the objective of encouraging the beneficial use of water in the Vaal River System.

As presented in **Section 2.8.1** and in the strategy "WATER BALANCE RECONCILIATION A.1.3**"** the conditional surplus is not available in the Grootdraai Dam catchment and no new licences can be considered in this area prior to the implementation of an augmentation scheme.

The possibility of allocating water from the available conditional surplus in the Vaal River System, to supplement the water resources of the Lower Orange WMA, has been identified as a potential option in the Lower Orange River Management Study. This is one of several options that are currently being investigated for feasibility and could possibly be a medium term solution to provide time for the implementation of infrastructural augmentation options.

2.8.4 Necessity for Compulsory Licensing:

Compulsory Licensing is a procedure defined in Section 43 of the National Water Act, which has the purpose of correcting imbalances in water allocations, making additional water available for

the Reserve or to meet reasonable equity demands. Due to the conditional surplus estimated until the year 2025, reasonable quality water, and, no eminent need for allocation corrections (required by the Reserve or water for equity), there is *no immediate* need to enter into a compulsory licensing process for any of the Vaal WMAs as a whole. It may be required to implement Compulsory Licensing in selected sub-catchments, which are dealt with in the WMA specific ISPs.

Due to the extensive developments in and large water abstractions from the Vaal River System, it may however be required, when the Reserve is implemented fully eventually, to introduce Compulsory Licensing. It should be noted that it is generally accepted that the Vaal River is a "workhorse" river and will most likely be maintained as such when the Resource Classification is carried out.

One of the main objectives of DWAF is redressing inequities in water allocation that originated from past policies. Licensing, in particular Compulsory Licensing, are measures now embedded in the NWA to accomplish these goals. Although limited requirements for such water allocation have been received in the Vaal River System, it remains a priority policy of the DWAF to give preference to legitimate equity water allocation needs.

2.9 WATER QUALITY MANAGEMENT

The water quality situation in the Vaal River System is such that, through intensive management and the implementation of previous and existing legislation, reasonable (in most cases acceptable) quality water has been available at most locations in the Vaal River System. This achievement was only possible through extensive management interventions that were taken to counter pollution that inevitably accompany economic development and population growth.

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. Atmospheric deposition has been cited as a cause of increased salinity, mainly in the Upper Vaal WMA.

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 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 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 and in the main stem of the Vaal River.

In order to deal with the situation it is required to commission the development of an Integrated Water Resource Management Strategy for the Vaal and Orange River systems. (See the "WATER QUALITY MANAGEMENT A.2.2" strategy's Management Actions that were identified in this regard.)

In summary the main challenges for water quality management in the Vaal River System will involve mitigating the future impacts particularly with respect to the following focus areas:

- Further expansion of the urban areas and industrial activities.
- Extension of coal mining activities (mainly in the Grootdraai Dam and Waterval River catchments).
- Managing potential decants from decommissioned gold and coal mines – the consequence of past economic activities.
- Addressing the problem of atmospheric deposition of sulfur (mainly occurring in the Upper Vaal WMA) that originates from the coal burning industries.

The general objective with any management intervention should be to balance the level of water resource protection measures that are implemented whilst allowing development to occur with the benefit being a sustainable economic, social and ecological environment.

2.10 INSTITUTIONAL ASPECTS

2.10.1 International and National Institutional Considerations

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 will be dealt with in the Lower Vaal WMA ISP.

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

2.10.2 Local and Catchment Level Institutional Considerations

The water management in the Vaal River System involves the three Vaal WMAs, the Orange River WMAs and the surrounding WMAs supplying or receiving water from the system. In addition communication with the local authorities, water supply and wastewater service providers (such as Rand Water and Erwat) as well as bulk users such as Sasol and Eskom are essential if the water resources of the Vaal River catchment are to be successfully managed. To this end, DWAF are active in several liaison forums with stakeholders on several fronts as well as promoting the establishment and continuation of Water Management Forums to create the

structures for stakeholder participation. There is a need to co-ordinate these activities and encourage communications between the various government and regional and local authorities.

2.11 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 objective among stakeholders. The main activities for system management include the following:

- Operation planning should be undertaken on an annual basis.
- 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 CMA. More details are provider in the strategy on “SYSTEM MANAGEMENT A.6.2”.

2.12 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.

Coordination 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 feed to the WMA managers for coordination. 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. (More details can be found in the “MONITORING AND INFORMATION MANAGEMENT STRATEGY A.7**”**.)

2.13 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 DWAFs perspective on how the Vaal 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 Agency is technically functional and a Catchment Management Strategy developed.

References:

DWAF (2004a) Department of Water Affairs and Forestry, South Africa, Report No. P WMA 08/000/00/0304. **Internal Strategic Perspective: Upper Vaal Water Management Area**. Compiled by PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3 on behalf of the Directorate: National Water Resource Planning, 2004.

DWAF (2004b) Department of Water Affairs and Forestry, South Africa, Report No. P WMA 09/000/00/0304. **Internal Strategic Perspective: Middle Vaal Water Management Area**. Compiled by PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3 on behalf of the Directorate: National Water Resource Planning, 2004.

DWAF (2004c) Department of Water Affairs and Forestry, South Africa, Report No. P WMA 10/000/00/0304. **Internal Strategic Perspective: Lower Vaal Water Management Area**. Compiled by PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3 on behalf of the Directorate: National Water Resource Planning, 2004.

DWAF (2004d) Department of Water Affairs and Forestry, South Africa, Report No. P C 000/00/22602. **Annual Operating Analysis for the Total Integrated Vaal River System (2002/2003).** Compiled by WRP Consulting Engineers, 2004.

DWAF (2003a) Department of Water Affairs and Forestry, South Africa, Report No. P WMA 08/000/00/0203. **Upper Vaal Water Management Area: Overview of Water Resources Availability and Utilisation**. Compiled by BKS (Pty) Ltd as part of the development of the National Water Resources Strategy, 2003.

DWAF (2003b) Department of Water Affairs and Forestry, South Africa, Report No. P WMA 09/000/00/0203. **Middel Vaal Vaal Water Management Area: Overview of Water Resources Availability and Utilisation**. Compiled by BKS (Pty) Ltd as part of the development of the National Water Resources Strategy, 2003.

DWAF (2003c) Department of Water Affairs and Forestry, South Africa, Report No. P WMA 10/000/00/0203. **Lower Vaal Water Management Area: Overview of Water Resources Availability and Utilisation**. Compiled by BKS (Pty) Ltd as part of the development of the National Water Resources Strategy, 2003.

DWAF (2003d) Department of Water Affairs and Forestry, South Africa, 2004. **National Water Resource Strategy:** First Edition.

DWAF (2002a) Department of Water Affairs and Forestry, South Africa, Report number PB C110/00/1200. **Vaal River System: Pre-feasibility Study to determine the need for augmentation of the Eastern Sub-system**. Compiled by East Vaal Consultants, 2002.

DWAF (2002b) Department of Water Affairs and Forestry, South Africa. Report No. P WMA 09/000/00/0101**. Middle Vaal Water Management Area: Water Resources Situation Assessment**. Compiled by Stewart Scott Consulting Engineers, 2002.

DWAF (2002c) Department of Water Affairs and Forestry. Report No. P WMA 08/000/00/0101. **Upper Vaal Water Management Area: Water Resources Situation Assessment**. Compiled by Stewart Scott Consulting Engineers, 2002.

DWAF (2002d) Department of Water Affairs and Forestry. Report No. P WMA 10/000/00/0101. **Lower Vaal Water Management Area: Water Resources Situation Assessment**. Compiled by Stewart Scott Consulting Engineers, 2002.

DWAF (1999) Department of Water Affairs and Forestry, South Africa, Report no: P C000/00/18596, 1999. **Vaal River System Analysis Update: Environmental considerations in the Vaal River System Analysis Study**. Compiled by a consortium of consultants for the Department of Water Affairs and Forestry, 1999.

DWAF (1997a) Department of Water Affairs and Forestry, South Africa, Report no: P C000/00/18496. **Vaal River System Analysis Update: Integrated Vaal River System Analysis**. Compiled by a consortium of consultants for the Department of Water Affairs and Forestry, 1997.

Reference pertaining to particular strategies are provided at the end of each of the strategy tables presented in Appendix A.

Appendix A

Vaal River System Overarching Strategy Tables

Vaal River System Overarching Strategies

INTRODUCTION TO THE STRATEGY TABLES

The first two chapters of the document describe the ISP process, paint a broad perspective of the water situation, and provide a description of the key issues that have to be dealt with. The crux of the ISP is located in a series of strategy tables presented in **Appendix A**. Strategy tables for each strategic area present: the management objective (what we are trying to achieve); an assessment of the situation along with a motivation as to why the strategy is required; the required actions; responsibilities; priorities; and relevant supporting references. A version control is attached for future versions of this Internal Strategic Perspective (ISP).

The issues raised in the situation assessment and at the workshops were grouped into those that are knowledge gaps, specific directives, requirements or guidelines and are listed in the situation assessment section of the strategy tables. Management Actions were then developed to address issues when appropriate.

The table below provides a brief description of the elements contained in the strategy tables and was included to creating some common understanding of what is meant by these elements.

Definitions of terminology used in the Strategy Tables

Management Objective	Description of what DWAF is trying to achieve
Situation assessment	Description of the current situation and motivation to support the specific elements listed below.
Gaps (G)	Lack of knowledge, data missing or incomplete or non-existent processes that are required.
Requirement (R)	A need or specific requirement.
Directives (D)	Indicating the way, manner or direction in which something should be done.
Guidelines (U)	The standard or principle by which to determine the action. (mainly refer to an existing document)
Management action (M)	Solutions to fill Gaps, adhere to Directives and to meet Requirements.

Strategies Table of Contents

A.1 WATER BALANCE AND WATER RESOURCE RECONCILIATION STRATEGIES

A.1.1 RESOURCE AVAILABILITY

Management objective:	Ensure reliable estimates of the water resources (surface and groundwater) are available to effectively conduct Integrated Water Resources Management. The factors impacting on the water resource availability need to be clearly defined and understood.
Situation Assessment:	**Surface water resources:** The surface water resources of the Vaal River System has been the subject of various studies aimed at developing and maintaining a reliable hydrological database and Decision Support System (DSS) for the management of the water resources. The DSS consists of a series of water resource simulation models that are capable of simulating both water and salinity (Total Dissolved Solids (TDS)) balances. DWAF officials use these models as decision support tools to assess the capability (availability) of the water resource as part of the Department's responsibility to undertake development and operational planning. The predominant characteristic of the Vaal River System that plays an important role in the management of the water resources is the numerous transfers in and out of the system with links to four other Water Management Areas (WMA). Due to the interdependencies that exist, DWAF has developed an Integrated Vaal River System Water Resources Planning Model to simulate all the water resource infrastructure that affects the Vaal River System. This includes the three Vaal WMAs, significant portions of the Inkomati, Thukela and Usutu to Mhlathuze water management areas as well as the Lesotho Highlands. This complex system has to be analysed as a single network in order to simulate the interdependency that exists due to the various inter-basin transfers. The currently applied (March 2003) hydrological database and DSS were compiled as part of the *Vaal River System Analysis Update Study (VRSAU)* and the main deliverables from the study are listed below: a. Hydrological time series database for the period September 1920 to October 1995. b. TDS model that were calibrated and verified against observes data. c. Water Resource Yield Model (WRYM) network configurations that were used to determine the long term yield capability for seven sub-systems. The Integrated Vaal River System Water Resources Planning Model (WRPM) that was configured to simulate both water quantity and salinity (TDS).

Situation Assessment: (Continued)

RESOURCE AVAILABILITY

Given the level of detail of the abovementioned study, it can be stated that there is a high level of confidence in the estimates of the available surface water resources in the Vaal River System when considering the main (large) water resource components.

It was however identified that the resolution of the network models will have to be increased to realistically simulate the water resource availability at tributary catchment level. In the current system configurations certain components (demands, tributary catchments and small dams) were "lumped" together as single elements to simplify the networks. Although the simplification is suitable for analysis of the large system, an increase in detail is needed to estimate the resource availability at tributary catchment level. This issue is dealt with in more detail in the WMA specific ISPs. **[G1]**

The impact which the implementation of Water Conservation and Demand Management could have on the return flows is not well understood and has not been estimated at a satisfactory level of confidence. **[G2]**

Updating or extension of the hydrological database should be considered under the following circumstances: **[D1]**

- When a significant drought event, comparable or more severe to events experienced in the past, occurs.
- If it is observed that the status of one or more of the factors listed above, as having a large impact on water resources availability, change significantly.
- Updating the hydrological data for the purpose of re-calibrating the TDS model. (See **Directive 2** below.)

The re-calibration of the TDS (salinity) model should be considered when it is found that the land use activities assumed in the VRSAU study have changed significantly and there is evidence that the reliability of the results produced by the models is questionable due to changed circumstances. **[D2]**

As part of the international review of the Vaal River System Analysis Update Study **(review of report [Ref. 1])** it was recommended that sensitivity analysis be undertaken of selected input parameters such as the growth in the salinity recharge rates of the developed catchments. **[R1]**

Factors that were identified as having significant impacts on the available surface water resources of the Vaal River System are listed below:

1. The combined effect of small farm dams.
2. Coupled with item 1, the users abstracting water from the tributary catchments has a significant impact on the water resources of the larger dams in the system.
3. The extension of the hydrological record by 11 years, and the associated extension of the critical period, had a major impact by reducing estimates of the yield of the Vaal River System by about 13%. **[Ref. 1]**
4. Runoff from impervious urban areas contributes to the available resources.
5. Return flows from sewage treatment plants contribute significantly to the available resources. This resource will also increase due to the growth in the urban areas.

Situation Assessment: (Continued) **RESOURCE AVAILABILITY**	**Groundwater resources:** Groundwater resources will have a small impact on issues of an Overarching nature and are dealt with in more detail in each of the WMA ISPs. As a general comment it is the view of the Department that groundwater is an important resource to supply geographically dispersed water users located in the catchments of tributary rivers to the Vaal River. This resource can be a cost effective water supply option for small towns and communities if properly managed and maintained. It is very important that the planning for extensions to existing or new water schemes always include an assessment of groundwater as a resource. A concern was raised regarding the management of groundwater resources that cross into water management areas outside of the Vaal River System. A committee has been established to investigate the possibility of changing the WMA boundaries to coincide with the boundaries of the groundwater resource or to establish management protocols in cases where the boundaries are not changed. This issue will be dealt with at a **National Level**. It was further identified that the interaction between ground and surface water resources are not well defined and that the impact abstractions from the one resource type may have on the other resource's availability is not well understood. It was also recognised that the current surface water resource models and analysis techniques have limited and insufficient capability to simulate the groundwater surface water interdependencies and needs further development. This issue affects various WMAs in the country and will therefore be addressed at **National Level**.

MANAGEMENT ACTIONS (RESOURCE AVAILABILITY)		
Required actions, responsibilities and priorities:	**M1.** Improve the knowledge base by developing a Return Flow Analysis Model (similar to that which is currently being developed in the Crocodile (West) River Return Flow Analysis Study **[Ref. 2]**) for the Vaal River System. Apply the model to assess the impact of Water Conservation and Demand Management measures on the demand and return flows. (Refer to **Management Action M3** of the "**WATER CONSERVATION AND DEMAND MANAGEMENT STRATEGYA.4**") **{G2}**	Dir: NWRP (Priority 2)
	M2. Develop higher resolution hydrological data and system models for targeted local resources for which there are indications that the water resources are under stress, allocations among users have to be resolved or where new abstraction licences need to be evaluated. Consideration should be given to how this refined data will link to the existing, larger scale, database and models. **{G1}**	Dir: NWRP (Priority 1)
	M3. Assess the need to update or extend the hydrological database on a continuous basis and commission studies accordingly. **{D1}**	Dir: NWRP (Priority 4)
	M4. Establish the need to update the TDS model by assessing the main variables that impacts on the salinity loads in the system on a continuous basis and commission studies accordingly. **{D2}**	Dir: NWRP (Priority 4)
	M5. Undertake sensitivity analysis of selected input variables and assess the impact thereof on the need for augmentation. **{R1}**	Dir: NWRP (Priority 2)
Interfaces:	**References:** **1.** DWAF report no: PC 000/00/18496, "*Vaal River System Analysis Update: Integrated Vaal River System Analysis*", Chapter 8.1. **2.** DWAF report no: PB A200/00/3802, "*Crocodile (West) River Return Flow Analysis Study: Inception Report*", 2003.	

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A.1.2 WATER REQUIREMENTS

Management objective:

Ensure the knowledge base on the water requirement in the three Vaal WMAs is realistic and updated on a regular basis. Furthermore, maintain and update water requirement scenarios for planning and management purposed.

Situation Assessment:

Water use data:

The actual water use data (see user composition in table below) are collated from the different DWAF offices and bulk users on an annual basis and currently captured in a spreadsheet database. This information is compared with the water requirement scenarios in order to assess the applicability of the scenarios and make adjustments to them (over the short-term) where needed. These scenarios are uses for the annual operating analysis of the system to determine the most appropriate operating rules.

Due to the detailed level of the investigation that were carried out as part of the Vaal River Irrigation Study **[Ref. 2]** the estimates on water use for irrigation is considered to be of acceptable reliability for planning purposes.

It should be noted that the actual water use for irrigation is only partially captured due to the data not being readily available and that in some cases no measurements take place. There is room for improving the collection and collation of the actual water use data in the irrigation sector.

The table below gives a breakdown of the water requirements between the indicated sectors and components for the year 2000. The total gross water use for the Vaal River System for the year 2000 was estimated at 3560 million m^3/annum.

Sector	Components	Percentage of Total Requirement	
Urban	Rand Water	36	45
	MidVaal Water Company	2	
	Sedibeng Water	2	
	Other towns and small industries	5	
Large Industries	Eskom	8	14
	Sasol I	2	
	Sasol II and III	3	
	Iscor	1	
Irrigation	Vaalharts/Lower Vaal	17	30
	Other	13	
Losses	Wetland and river losses	11	11

Situation Assessment: (Continued)

WATER REQUIREMENTS

Water requirement scenarios:

The water requirement scenarios currently used for planning originate from the National Water Resources Strategy. For the Urban Sector, the most probable scenario is based on the so-called "**Ratio Method**". In short this method uses the same ratio between the domestic portion and the remaining portion (commercial, industrial and other) as observed in 1995 to project the urban water requirement into the future (see **[Ref. 1]** for a summarised description of the scenario generation method).

The water requirement scenario generation method adopted for the NWRS took into consideration socio-economic factors and fertility rates as driver variables for population growth and migration patterns among more than 700 Consumption Centres in the country. By nature this scenario generation method allows for factors beyond water management area boundaries which implies that water requirement scenarios have to be made from a national perspective. The determination of water requirement scenarios should be founded on actual water use data and the correlation thereof with the driver variables such as population and economic parameters. Water requirement scenarios to be used for water resource planning should therefore be carried out at the **National Level**. **[R1]**

The water requirement scenarios for the large industrial users (see table above) were obtained from the users themselves.

It was further assumed that the irrigation water requirement would remain constant from what was determined from the Vaal River Irrigation Study **[Ref. 2].**

Indications are that the registered water use is substantially more than that used in the model. It is therefore essential to compare the data in the model with verified use once the verification process is completed. **[R2]**

The water requirements for the wetlands and river losses are calculated in the water resource models and, among other variables, depend on the volume of flow through the systems and climatic conditions.

The main bulk users, Rand Water, MidVaal Water, Sedibeng Water, Eskom and Sasol provide water requirement scenarios on an annual basis. These scenarios are compared with previous scenarios to determine the level of deviation as well as possible changes in trends. Comparisons of these scenarios are made with the NWRS scenarios and adjustments are made where appropriate, mainly over the short term. The general approach is to maintain the long term future water requirement scenarios as was defined in the NWRS and only make adjustments over the short term. The intention is that the NWRS scenarios will be updated at about five year intervals.

Indications (in the year 2003) are that Eskom is experiencing elevated water use, higher than previous water requirement scenarios, and that Sasol is expecting higher growth in demand in excess of what was projected. The consequences of higher future water requirement scenarios for these two users are that the date when the Eastern Sub-system has to be augmented will be earlier than scheduled in the the Vaal River Eastern Sub-system Study (VRESS) **[Ref. 3]** **[R3]**

Situation Assessment: (Continued) **WATER REQUIREMENTS**	The responsibility for any water requirement scenario, that will be used in a decision making purposes (i.e. for deciding when to implement an augmentation scheme) is on the user themselves since it will represent a commitment of the user with respect to the cost of the proposed scheme. In all cases the user's scenarios will be checked against the planning scenarios referred to in **R1** above. **[R4]** **Return flows scenarios:** Actual return flow (urban wastewater) data are not captured continuously on an annual basis. In the past this data were only collated as part of the hydrological studies for calibration purposes. Currently the return flows are simulated as a direct proportion of the use and it is assumed that the proportion stays constant for the future scenarios. Due to the importance of this source of water and the possible impacts changes in user behaviour could have on the return flows it is proposed that, in future, the data be collected and analysed annually. Comparisons of the recorded data with the estimates will show where deviations occur and will ensure appropriate management actions can be taken accordingly. (See also the strategy on "**RESOURCE AVAILABILITY A.1.1**" for the importance of this resource and thus the need to have reliable planning information) **Registration of water use:** This process has been largely completed and indications are that the registered use is much higher than the previous estimated water use. The process of verification of actual (existing) water use and the lawfulness of that is in progress.

MANAGEMENT ACTIONS (WATER REQUIREMENTS)		
Required actions, responsibilities and priorities:	**M1.** The process of verification of existing lawful use must be completed as soon as possible. Comparisons should be made between the lawful use and the water use data applied in the water resource system models. In this process the water use database can be supplemented by using satellite images of areas under irrigated and crop water use calculations, particularly for irrigation outside of the main schemes, to estimate irrigation water use. (Refer to **Management Action M1** of the strategy on "**MONITORING NETWORKS AND DATA CAPTURING A.7.1**" **{R2}**	Regional Office (Priority 1)
	M2. Update the water requirement scenarios of the Eastern Sub-system as a priority activity. These scenarios are urgently required for the feasibility study and implementation of a scheme to augment this subsystem. **{R3}**	Dir: OA (Priority 1)
	M3. The water requirement scenarios of the Vaal WMAs and other related supply areas must be updated at regular intervals by the users themselves with co-ordination by DWAF. This must be co-ordinated with overall scenarios of population and economic growth for the whole country. **{R1,R4}**	Dir: NWRP (Priority 1)
Interfaces:	**References:** **1.** DWAF report no: PC 000/00/22502, "*Vaal River: Continuous Investigations (Phase 2), Revision of the augmentation requirements for the Integrated Vaal River System (2001)*". **2.** DWAF report no: PC000/00/21599, "*Report for the Vaal River Irrigation Study", September 1999.* **3.** DWAF report no: PC110/00/0800, "*Vaal River System: Pre-feasibility study to determine the need for Augmentation of the Eastern Sub-system: Main Report*", 2001. **4.** DWAF reports describing the Water Resources Situation Assessment Study of the Upper, Middel and Lower Vaal Water Management Areas.	

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A.1.3 WATER BALANCE RECONCILIATION

Management objective:	Maintain a balance between the water requirements and water availability (now and in the future) while applying the allocation priorities defined in the National Water Act, ensure equitable sharing of the water as well as making allocations for poverty eradication initiatives.
Situation Assessment:	**Overall water balance situation (Integrated Vaal River System):** *Current Knowledge:* The Vaal River System is a component of the extended Vaal River System for which the latest estimate of the water balance **[Ref. 1]** indicated the following balance results: ● A slight surplus of 19 million m^3 is estimated for the year 2000, excluding the contribution of Phase 1B (Mohale Dam and transfer tunnel) of the Lesotho Highlands Water Project (LHWP) to be commissioned in 2003. ● With Phase 1B of the LHWP in place, it was projected that excess supply conditions will exist until the year 2025 when further augmentation would be required. It is important to note that the indicated excess or surplus is only available under the condition that pumping occurs from the Thukela-Vaal Scheme. The available excess in supply is therefore qualified as a **conditional surplus** and estimated at about 300 million m^3/annum. This represents less than 9% of the year 2000 gross demand imposed on the Vaal River System. In practice the volume of water conveyed through the Thukela-Vaal Transfer scheme will be reduced, to save pumping costs, effectively operating the system such that the water demands are in balance with the supply. ● Although the above holds true of the system as a whole, additional augmentation is required by about 2010 for the Eastern Sub-systems consisting of Grootdraai Dam and supporting systems. The pre-feasibility study determined that a dam on the Klip River (Free State) with transfers into Grootdraai Dam is the best contender followed by the Merikloof Dam (Usutu) and the Vaderlands Dam (Pongola) options. This was based on economic considerations only. Subsequent to the pre-feasibility study Eskom indicated that in order to minimise the total risk of water supply the pipeline option to transfer water from Vaal Dam would be preferred. The Vaal pipeline option has the advantage that water can be accessed from both the Thukela River and Lesotho Highlands rivers, which decreases the vulnerability with respect to localised droughts in the catchments of the Eastern Sub-system. *Important qualification with respect to the indicated conditional supply surplus:* a. The estimated excess supply indicated above only exists if the inter-basin transfers are operated at maximum capacity.

Situation Assessment (Continued)

WATER BALANCE RECONCILIATION

b. During the period of excess supply, the operating rules of the inter-basin transfers will be adjusted to reduce the transfer volumes to achieve pumping cost savings. This will only be allowed when it is proven that the long-term reliability of supply are not jeopardised due to the loss of water from the supporting systems.

c. From the water balance situation it can be deduced that the indicated conditional surplus will be taken up by the growth in the water requirements over the next twenty years. It is therefore considered appropriate for new users to share in the conditional surplus by allowing further abstraction licences.

d. In all cases new users will have to pay the full Vaal River Tariff with respect to the impact they have on the reduction of the positive water balance.

Reconciliation options and perspective:

Although it is projected that the water resources will be sufficient to supply the water requirements until the year 2025, it is important to present the possible reconciliation measures that are available in the Vaal River System, should it be required over the medium term or beyond the year 2025.

- Water Conservation and Demand Management could have a significant impact on postponing the date intervention (augmentation) is required. This is due to the relative low growth rate of the projected future water requirements and preliminary indications that indicated significant savings can be achieved through WCDM. (See the "**WATER CONSERVATION AND DEMAND MANAGEMENT STRATEGY A.4**" for further details regarding the proposed planning requirements and management actions relating to WCDM.)
- In line with current planning methodology applied by DWAF, intervention by means of infrastructure development should only be considered once it has been proven that improved efficiency of water use through water conservation and demand management cannot satisfy the needs for augmentation. In all cases all potential augmentation options should be compared on the basis of economic, social, environmental and more specific ecological criteria in order to find the most feasible solution.
- Planning investigations were undertaken on several augmentation options in the past as part of the Vaal Augmentation Planning Study and several studies on further phases of the Lesotho Highlands Water Project (LHWP). According to the current knowledge the next augmentation scheme to be implemented will either be the Thukela Water Project or a further phase of the LHWP.
- After completion of the Comprehensive Reserve Determination Study for the Thukela River Catchment, consolidate all planning information so as to allow further planning phases to proceed efficiently.
- The projected future water balance is based on estimates of what the water requirements will be in future are by nature uncertain. To make appropriate adjustment to the reconciliation plans it is required to undertake continuous assessments of the water balance as new improved information become available. **Management Action M3** below related to this requirement.

Situation Assessment (Continued)

WATER BALANCE RECONCILIATION

*Other **g**aps in the knowledge base not identified above:*

There are two variables (one on each side of the balance scale) that could change the projected balance situation as described below:

G1. Water Conservation and Demand Management (WCDM) was not taken into consideration in the balance presented above. This is mainly due the lack of information with respect to data indicating how the various measures that are being implemented by the different authorities will impact on the long-term water requirement as well as the return flows.

G2. The water balance makes allowances for the Ecological Reserve using low confidence Desk Top estimates for the purpose of developing the National Water Resources Strategy (NWRS). Subsequent to the publication of the NWRS, a cursory assessment indicated that the positive water balance could decrease by as much as 300 million m^3/annum when using the flow requirements derived as part of the Vaal River System Analysis Update Study, also referred to as a Flow Management Plan for the Vaal River. No urgent Reserve issues were identified during the Overarching Workshops, however, the above factors point to the need for careful planning and implementation of the Ecological Reserve to balance, among other things, the economic consequences and ecological benefits. Due to the interdependencies of the triturates with the main stem of the Vaal River, it will be required to undertake the determination in an integrated way, balancing tributary contributions with the flow requirements of the main stem.

A further complication with respect to the Ecological Reserve is that the water resources of the Integrated Vaal River System straddle, apart from the three Vaal WMAs, three other WMAs for which the Ecological Reserve needs to be determined. (A strategy for the determination and implementation of the Ecological Reserve is discussed in Management Action **M1** of the strategy on "**RESERVE AND RESOURCE QUALITY OBJECTIVES A.2.1**")

The view on the above two variables (WCDM and Ecological Reserve is that, since they are at opposite ends of the water balance scale, they could be managed in such a way that the supply to the Ecological Reserve could be made by savings through WCDM measures. **[R1]**

*Other **d**irectives, g**u**idelines or **r**equirements identified from available information:*

R2. At this stage only a pre-feasibility study has been undertaken with respect to the planning of a proposed scheme to augment the Eastern Sub-systems. The planning process needs to be taken further through a feasibility study to be succeeded by detailed design, financing, tendering, construction and implementation of the selected option.

D1. The conditional surplus, indicated above, is available to supply the growth in the requirements in the system. Users can apply for licences for new requirements, as well as, growth in existing requirements. In all cases the normal criteria will be used to evaluate the licences according to departmental policies. All new uses will have to be pay the full system tariff for the water. (See the strategy on "**LICENSING A.3.2**" for the conditions according to which the surplus should be allocated.)

MANAGEMENT ACTIONS (WATER BALANCE RECONCILIATION)		
Required actions, responsibilities and priorities:	**M1.** The impact WCDM measures could have on the projected supply situation must be determined. The products of the proposed Return Flow Analysis Study, described under **Management Action M1** of the strategy on **"RESOURCE AVAILABILITY A.1.1",** and the study described in **Management Action M3** of the "**WATER CONSERVATION AND DEMAND MANAGEMENT STRATEGY A.4**" should proof to be useful sources in re-determine the projected water balance. **{G1}**	(See referenced strategy)
	M2. A Feasibility Study should commence to determine what options should be taken further in the planning process to augment the Eastern Sub-systems. Further activities are discussed under the "**INFRASTRUCTURE DEVELOPMENT AND SUPPORT A.6.1**" **strategy**, **Management Action M2**. **{R2}**	Dir: OA (Priority 1)
	M3. With reference to components shown in **Figure 1.4** of **Section 1.4** and the reconciliation perspective given in the Situation Assessment 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.	Dir: NWRP (Priority 2)
Interfaces:	**References:** **1.** Comments on the water balance presented in the first draft of the NWRS for the Upper, Middle and Lower Vaal WMAs, 2003. **2.** DWAF report no: PC000/00/22502, "*Vaal River: Continuous Investigations (Phase 2), Revision of the augmentation requirements for the Integrated Vaal River System (2001)*". **3.** DWAF report number PBC110/00/1200, "*Vaal River System: Pre-feasibility Study to determine the need for augmentation of the Eastern Sub-system*", 2002.	

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A.1.4 TRANSFERS AND RESERVATION OF WATER

Management objective:	Secure sufficient transfers into the Vaal River System to augment the local water resources and reserve adequate water resources to support the transfers out of the WMAs.
Situation Assessment:	**Overview:** **Figure 2.1, Figure** 2.2 and **Figure** 2.3 in **Chapter 2** give geographical representations of the transfer into and out of the three Vaal WMAs. According to the NWRS all inter-WMA transfers are under control of the Minister. **Existing transfers into the Vaal River System:** There are six inter basin transfers into the three Vaal WMAs as listed below: 1. Transfer from Heyshope Dam, located in the Usutu - Mhlathuze WMA, to augment Grootdraai Dam. 2. Transfer from Zaaihoek Dam in the Thukela WMA to supply Majuba Power Station and augment Grootdraai Dam. 3. Thukela-Vaal Transfer Scheme supplying water from the Upper Thukela into Sterkfontein Dam. 4. Transfers from Lesotho (LHWP) into the Liebenbergsvlei River augmenting the water resources of Vaal Dam. 5. The fifth transfer scheme is into the Lower Vaal WMA conveying water from the Upper Orange WMA in support of the irrigation water requirements supplied from Douglas Weir. 6. Water that is transferred from the Usutu - Mhlathuze WMA to support the power stations in the Olifants WMA, crosses the Upper Vaal WMA and also supplements the water supply to the town of Ermelo. **Existing transfers out of the Vaal River System:** The two main transfers conveying water out of the system are listed below: 1. Water is transferred to support the thermal power stations in the Olifants WMA from Grootdraai Dam. 2. Transfers to the Crocodile West & Marico WMA supporting the bulk of the urban water requirements in the Tshwane and northern portion of the Greater Johannesburg Metropolitan areas. **Release obligation between the Vaal Water Management Areas:** The cascading orientation of the three WMAs in the Vaal River System and the disproportionate distribution of the water resources, dictated by the decreasing annual average rainfall in the direction of the river flow, necessitate that significant obligatory releases (considered to be in national interest) have to take place from the Upper to the Middle and from the Middle to the Lower Vaal WMAs. In accordance with the NWRS, these inter-WMA transfers (releases) are under the control of Minister.

Situation Assessment: (Continued)

TRANSFERS AND RESERVATION OF WATER

Upper Vaal to Middle Vaal release obligations:

In the NWRS an average annual release is specified based on the yield balance in the Middle Vaal WMA using a 1:50 year return period basis. In practice however the flow from the Upper to Middle Vaal WMA is made up of several components as listed below:

- Spills and incremental runoff during high flow conditions.
- Outflow from the Vaal Barrage as a result of releases from Vaal Dam for the blending rule to maintain the TDS concentration water in the Vaal Barrage at 600 mg/l.
- Releases to support the water requirements of Midvaal Water and Sedibeng Water.
- During prolonged drought events when Bloemhof Dam is depleted; large volumes have to be released to support the water requirements of both the Middle and the Lower Vaal WMAs.

Middle Vaal to Lower Vaal release obligations:

Bloemhof Dam is the most downstream control structure in the Middle Vaal WMA and most of the water requirements in the Lower Vaal have to be released and controlled from the dam. The flow between the two WMAs is therefore driven by the requirements in the Lower Vaal WMA with occasional uncontrolled spills from the dam.

Future transfers into the Vaal River System:

1. The transfer from the LHWP will be increased with the commissioning of Mohale Dam and transfer tunnel in 2003.
2. Based on the reconciliation status given in the strategy on "**WATER BALANCE RECONCILIATION A.1.3"** it is shown that augmentation will be required by 2025. Current planning information indicates this augmentation could be either the Thukela Water Project or further phases of the LHWP.

Future transfers out of the Vaal River System:

The transfers to the Olifants, Crocodile West and Marico WMAs are expected to increase over time to support the growing urban water requirements. (This is part of the projected water requirements used in the 2025 water balance.)

Future release obligations between the Vaal WMAs:

The release obligations between the WMAs will only experience minor increases in future. This is due to the relatively low increase that is expected in growth of the water demands in the Middle and Lower Vaal WMAs.

Situation Assessment: (Continued) **TRANSFERS AND RESERVATION OF WATER**	***D**irectives, g**u**idelines or **r**equirements identified from available information:* **D1.** The management of all the transfers and release obligations should be undertaken using the Integrated Vaal River System model. This model encompasses the entire Vaal River and supporting systems and simulates all the interdependencies that are crucial for proper operation of the system. (See **Management Action M1** of the strategy on "**SYSTEM MANAGEMENT A.6.2**".) **D2.** Cost saving operating rules (i.e. reduction of pumping from the Thukela) should be implemented for the transfers during periods of high runoff and high dam levels. The decision to implement such rules should be taken only if it can be shown that the long term assurance of supply is not jeopardised. See also the strategy on "**SYSTEM MANAGEMENT A.6.2**".

MANAGEMENT ACTIONS (TRANSFERS AND RESERVATION OF WATER)		
Required actions, responsibilities and priorities:	**M1.** Implement cost saving operating rules for the transfers. In all cases the cost saving transfer rules should not jeopardise the long-term supply reliability in any of the effected water resource systems. **{D2}**	Regional Office (Priority 1)
Interfaces:	**References:**	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.1.5 COMPULSORY LICENSING

Management objective:	Ensure the equitable sharing of the available water resources for both the Reserve and to reduce past inequities whilst maintaining the economic and social structures that rely on the water resources of the Vaal River System.
Situation Assessment:	*Status Quo:* Considering the three variables (Reserve, water for equity and a negative water balance) that could drive the need for Compulsory licencing, the status is as follows: ● Due to the excess supply situation as indicated in the Reconciliation Strategy, there is no need to implement compulsory licensing on the grounds of water supply constraints. ● Currently the Comprehensive Ecological Reserve has not been determined for the WMA and no urgent Reserve issues were identified during the Overarching Workshops that pointed to the need for Compulsory Licensing on the basis of pressures brought upon by the Reserve. ● The economic activities supported by the water resources in the Vaal River System is recognised as the economic engine of South Africa. The key purpose in allocating water must be to keep this economy to prosper to the benefit of all. The specific need to move water into the hands of the historically disadvantaged is not seen as the focus in the Vaal River System. Indirectly, by supporting the economic activities, secondary opportunities are created in the form of revenue for the government that can be allocated for worthy causes such as land restitution. ● Although the above status indicates that Compulsory Licensing is not a priority in the whole Vaal River System, it may be required in selected sub-catchments. ● The above presented view, as well as, the principle that all new water use will pay the full cost for water (see the strategy on "**LICENSING A.3.2**") effectively rules out any increases in irrigation from surface water resources. Redistribution of equity irrigation water can take place through land redistribution, however, it could also be done through Compulsory Licensing. This need will be determined in the WMA ISP workshops and reflected in the ISPs for the individual WMAs. ***D**irectives, g**u**idelines or **r**equirements identified from situation assessment:* **D1.** Based on the situation assessment it is evident that Compulsory Licensing is not a priority for the Vaal River System as a whole. There may be specific catchments in the system where the priority is higher. These priority areas are identified as part of the WMA specific ISPs. **(No specific Management Actions are required)**

Strategy Version control:	**Version number:**	1
	Date:	March 2004
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A.2 WATER RESOURCES PROTECTION STRATEGY

A.2.1 RESERVE AND RESOURCE QUALITY OBJECTIVES

Management objective:	The Vaal River catchment and its various tributaries and reaches needs to be classified in terms of the new classification system to ensure a balance between environmental health and the optimal use of the resource. Ultimately a Comprehensive Reserve determination needs to be undertaken for the Vaal River catchment, with the Reserve being implemented and enforced.
Situation Assessment:	The Vaal River Catchment has sub-catchments whose natural flow and water quality regimes are significantly changed from natural conditions, whilst others are close to natural. The impacted river systems in the Vaal River catchment are highly regulated by major and small dams. The natural flow patterns in many of these river reaches have been substantially modified by return flows from wastewater treatment plants, mine dewatering, agricultural return flows and releases of water from transfer schemes into the river systems. It is believed that the ecosystems have largely adapted to the changed flow and water quality regimes. There are also substantial areas of the Vaal River catchment where land use development is low and the flow patterns are therefore largely unimpacted (e.g. Klip River (Free State), tributaries of the Wilge River and selected catchment upstream of Grootdraai Dam in the Upper Vaal WMA). A Comprehensive determination of the Reserve has not been done for the Vaal River Catchment **[G1]**. However, as part of the VRSAU study an Environmental Flow Management Plan was developed for the main stem of the Vaal River **[Ref. 1]**. The products from the study were basic definitions of flow requirements and preferred operating regimes. The scope of the study did not include the development of flow duration curves, which is the current applied method of simulating In-stream Flow Requirements (IFR) in the water resource models. Currently applied reservoir release and transfer operating rules do not explicitly contain the flow requirements and patterns defined in the abovementioned study. **[G2]** The RDM directorate has also determined low confidence desktop estimates of the IFR and in some cases the water quality Reserve for critical catchments where the Reserve is needed for the issuing of licences. The water resources of the Vaal River System are augmented by transfers into the catchment from adjacent WMAs. The ecological Reserve still needs to be determined for many of the catchments supplying the Vaal River System. The implementation of these Reserves and the Vaal River Catchment Reserve will affect the water availability in the Vaal River System. The impact of the implementation of the Reserves for the various augmentation schemes and the Vaal River System will have to be derived and an implementation schedule determined.

Situation Assessment (Continued) **RESERVE AND RESOURCE QUALITY OBJECTIVES**	Other identified **gaps** in the knowledge base: **G3**. The timing for the determination of the comprehensive Reserve needs to be planned. *Additional **D**irectives, g**u**idelines or **r**equirements identified from available information:* **R1.** Continue to determine the Ecological Reserve, using the Desktop, Rapid and Intermediate determination methods in support of the Licensing of water use. **R2.** Implementing the Ecological Reserve in the Vaal River System will most likely have the indirect cause that further and more expedient augmentation options will be needed. The merits of improving the ecological status in the Vaal River at the cost of degrading the Ecology in a source catchment should be assessed when the Comprehensive Reserve is determined. **D1.** The Department has the view that the Vaal River is a "workhorse' river and that the Ecology thereof should be managed to prevent further degradation and improve areas where unacceptable ecological conditions exists without causing a significant reduction in the water availability. (*This directive was included after comments were received from DWAF officials and is in reaction to a need that was expressed requesting a statement on DWAF's view regarding the implementation of the Reserve. This directive was therefore not tested by all Directorates*.) **D2.** With respect to contributions of the Vaal River to support the Reserve in the Lower Orange WMA the situation and perspective is as follows: a. The current system configuration is such that the Vaal River System already relies on large quantities of water transferred from the Orange River through the LHWP. b. Any release obligation from the Vaal River to the Orange River for the Reserve will result in additional transfers from the Thukela WMA (over the period leading to the year 2025) as well as expediting the date when augmentation to the Vaal River System is required (bringing the 2025 balance date forward in time). This will in effect imply that a further augmentation scheme will be implemented to supply the reserve in the Lower Orange WMA, in essence exchanging one environmental impact for another. c. It is therefore the perspective that the Reserve requirements in the Lower Orange WMA have to be supplied from the Upper Orange WMA and not the Lower Vaal WMA.

MANAGEMENT ACTIONS (RESERVE AND RESOURCE QUALITY OBJECTIVES)		
Required actions, responsibilities and priorities:	**M1.** The RDM Directorate should investigate what the status of the Environmental Flow Management Plan is with respect to current Reserve Determination methodologies. Furthermore the implementation of the conditions and flow requirements into the operating rules of the system should be investigated and the impacts determined. The intention is to establish if the Environmental Flow Management Plan can be implemented as an interim measure prior to the determination and implementation of the Comprehensive Reserve for the Vaal WMAs. **{G1}**	Dir: RDM (Priority 1)
	M2. The time schedule for determining the Comprehensive Reserve is needed for the Vaal River. A committee needs to be established to assess if the Reserve for the entire catchment and or system needs to be determined or only sections of the catchment and when should this determination take place. This determination should be co-ordinated with catchments augmenting the Vaal River System and the determination of the Orange River Reserve. (See **Management Action M1** of the strategy on "**COMPULSORY LICENSING A.1.5**") **{G1 and G3}**	Dir: NWRP (Priority 1)
	M3. The status of the Vaal River as a "working" system need to be assessed by the RDM Directorate. **{D1}**	Dir: RDM (Priority 2)
Interfaces:	**References:** **1.** DWAF report no: PC000/00/18596, "Vaal River System Analysis Update: Environmental considerations in the Vaal River System Analysis Study", 1999.	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.2.2 WATER QUALITY MANAGEMENT

Management objective:	The Department has a mandate to manage water resources in a sustainable manner and to pursuit activities that stimulate development and socio-economic growth which unfortunately are associated with negative water quality impact. The main objective is therefore to ensure a sound and reasonable balance between development and the protection of the resource. Fitness for use by all users (especially downstream users) and protection of the natural ecosystems must form the basis for strategy development.
Situation Assessment:	The water quality in the Vaal River catchment varies from poor in the highly developed areas to good in the less developed areas. The land use in the catchment includes agriculture, extensive gold and coal mining, power generation, industrial activities and urban developments. The industrial activities include mineral processing plants, steel industry, petrochemical industries, fertiliser manufacture, pulp and paper and light industry located in and around the urban centres. The urban developments consist of cities, towns and dense settlements. There are also dolomitic compartments in the Wonderfonteinspruit and Blesbokspruit catchments, which have been dewatered by mining activities. All these activities impact on the surface water and groundwater quality in the catchment. The water quality in many of the catchments is determined by the point source discharges from wastewater treatment plants, industrial effluent discharges and mine dewatering. The water resources of the Vaal WMAs are supported by transfers from adjacent catchments. These transfers are generally released into the rivers in the catchment and also impact on the water quality of the catchment. There are a number of coal fired power stations in the Olifants River catchment to the north of the Vaal River catchment as well as in the Vaal River catchment. The power stations as well as the steel industries and Sasol all contribute to the mass of pollutants emitted to the atmosphere. The deposition of pollutants from the atmosphere has been cited as a cause of the deterioration of the water quality in the Vaal River catchment. **[Ref. 1]** The flow in the main stem of the Vaal River, downstream of Vaal Dam and upstream of Bloemhof Dam, is largely influenced by the blending and/or dilution options that are implemented to maintain the TDS concentration at acceptable levels for users receiving water from the Vaal Barrage. These measures were required due to the high salinity content of the mine dewatering as well as the diffuse sources originating from the highly urbanised areas, all discharging into the catchment of the Vaal Barrage. In addition, large volumes of treated effluent also discharge into the Vaal Barrage of which the re-use has to be maximised to enhance the benefit obtainable from the resource. Several studies investigated what blending and or dilution rules should be implemented and the current practice is to apply one of the following rules:

Situation Assessment: (Continued)

WATER QUALITY MANAGEMENT

a. *Best quality, worst re-use option*: Supply Rand Water only from Vaal Dam and release water from Vaal Dam for dilution to maintain the TDS concentration in the Vaal Barrage at 600mg/l.

b. The second rule attempts to maximise reuse by supplying Rand Water users with a blend of water from Vaal Barage and Vaal Dam with the objective to maintain the TDS concentration at a maximum of 300 mg/l.

c. A third rule is a combination of the first two where both rule (a) and (b) are applied simultaneously to achieve some level of reuse and improve the water quality of the users downstream of Vaal Barrage. This third rule can however not be implemented fully due to the long water body of the Vaal Barage and the location of existing off-takes which hinders proper blending to be achieved in the Vaal Barrage.

The need for more stringent blending targets has been expressed by users downstream of the Vaal Barrage and changing conditions with respect to the mine dewatering highlights the need to revisit these rules as a matter of priority. **[R1]**

During 1997 the Amanzi Study investigated the possibility of desalinating the mine water, as an option to manage the high saline source for the remaining lifetime of the mines and after decommissioning. The study concluded that it will be technically feasible to desalinate, however, the economic viability was not favourable for a private initiative at that point in time.

The Department is currently developing a Waste Discharge Charge System under which dischargers will have to pay for the pollution caused. It is expected that this system will have a significant, mainly positive, impact on water quality management of the Vaal River System.

The approach adopted by the Department of Water Affairs and Forestry in managing the water quality in the Vaal River catchment is to set water quality objectives (WQO) for the sub-catchments. The WQO are based on the water user requirements in the catchments. The WQO include ideal, tolerable and unacceptable objectives for the water quality variables. A phased approach has been adopted for the development of strategies to manage the water quality in the sub-catchments of the Vaal River Catchment. The first phase is a situation assessment and setting WQOs, which is followed by further phases to develop catchment management strategies.

The currents status is that WQOs have been set for the whole of the Upper Vaal WMA, some in the Middel Vaal and none in Lower Vaal. Studies that are under way are on the Schoonspriut River and Vals River catchments.

What has not been assessed up to now is the cumulative effect on the main stem of the Vaal of the WQO's set for the various sub-catchments.

Furthermore, the Vaal River catchment is a cascade of three WMAs. The water quality of the main stem of the Vaal River in the downstream WMAs is therefore impacted on, not only by the activities in the WMA itself, but also by the water received from upstream. The water quality in Vaal River will also impact on the water quality of the Orange River in the Lower Orange WMA. A water quality management strategy can therefore not be developed in isolation for individual WMAs but the entire Orange River System will have to be considered in an integrated manner.

Situation Assessment: (Continued)

WATER QUALITY MANAGEMENT

The above situation description point to an urgent need for an integrated study to develop an overarching WQM strategy for the whole of the Vaal River System and possibly the Orange River System as well. Such an overarching strategy will have to feed back into the strategies of the various sub-catchments in order to make adjustments in an iterative process. **[G1]**

Possible components of the proposed study and an integrated water quality management strategy is listed below:

- The TDS dilution limit applied in the Vaal Barage (currently set at 600 mg/l) needs to be re-evaluated and possibly lowered. This will benefit the water users in the Middle Vaal.
- What is needed is an integrated modelling approach that will assist in evaluating the benefits that can be expected from, for example, mitigation efforts carried out in sub-catchments and the effects on the rest of the system.
- A study of the Vaal and Orange rivers should be formulated to develop an integrated water quality management strategy for the two river systems. The plan should be developed as two linked studies rather than a single large study of the two systems.
- The proposed study should devise methods of integrating quantity and quality management more closely.
- The study should identify and quantify sources of pollution.
- Salinity is the primary variable of concern but nutrients should also be considered.
- The setting of attainable Water Quality Objectives (WQO) and allocations of waste load should be made.
- The principles of the national waste discharge charge system strategy must be applied.
- Develop (or advise) water quality modelling systems that can be used for integrated water resource management. Consideration should be given to the integration of small scale catchment models with the larger system models.
- The study should focus on using available data and modelling systems as far a possible to develop management plans. The study should preferably not undertake time consuming intensive re-calibration of models.
- The need has been identified that some of the funds generated by the waste discharge charges in the Upper Vaal WMA should be allocated for the treatment of the water that is supplied to the users in the Middle and Lower Vaal WMAs. Such mechanisms should possibly be addressed as part of the proposed study.

MANAGEMENT ACTIONS (WATER QUALITY MANAGEMENT)		
Required actions, responsibilities and priorities:	**M1**. An integrated water quality management strategy needs to be developed for the Vaal and Orange River Systems. **{G1}**	Dir: NWRP (Priority 1)
Interfaces:	**References:** 1. Vaal Dam Salinity Assessment with particular reference to atmospheric deposition. By CE Herold and A Gorgens for HRI and DWAF, February 1991	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.3 WATER USE MANAGEMENT STRATEGY

A.3.1 GENERAL AUTHORISATION

Management objective:	To optimise the use of General Authorisation limits and rules with a view to cutting down on unnecessary administrative efforts of water use activities that can be allowed without individual water use licences. Both the DWAF and the users falling in the General Authorisation category would save resources (time and money) by not having to apply for and process licenses for the specified low impact water use activities. Details regarding what general authorisation is required in the catchments are discussed in the WMA specific ISPs and the only requirement from an overarching perspective is to ensure that relevant General Authorisation should be coordinated among the WMAs where appropriate.

A.3.2 LICENSING

Management objective:	To manage the "conditional" surplus and ensure that the water resources are used efficiently to best benefit of the country. The reserves are intended to support growth but must also be conserved for the future benefits.
Situation Assessment:	**Considerations for water abstraction licences:** Due to the "conditional" excess water available in the Vaal River System (see the strategy on "**WATER BALANCE RECONCILIATION A.1.3**") the issuing of licences for water abstraction could be considered under specific conditions as listed below. This opportunity for new licences is made possible only as a result of the transfer of water into the system, which implies that the full cost of the water will have to be charged for the intended user. Because water is transferred into the system and is available not only to users in the Vaal WMAs, but also to users in other WMA's, the allocation of the surplus will remain under DWAF's national control. *Directives and guidelines to apply when evaluating new licences to be allocated from the conditional surplus:* 1. Apply the fundamental allocation priorities defined in the Water Act. 2. The full surplus will be held by the national government. 3. No new licence application will be considered unless water conservation and demand management is satisfactorily practiced and proved. 4. As indicated in the "**WATER BALANCE RECONCILIATION A.1.3**" strategy, the Eastern Sub- system of the Vaal River System will require augmentation by about 2010. Due to this situation all available resources in the Eastern Sub-system are allocated to support the growth in the water requirements of existing users and no new license applications will therefore be considered upstream of Grootdraai Dam until new water supply infrastructure is in place. 5. An applicant with direct access to water from a transfer scheme will be able to receive a license for water abstraction at the full cost. Direct access referrers to all users abstracting water directly from the main stem of the Nuwejaarspruit / Wilge rivers downstream of Sterkfontain Dam, Ash/Liebenbergsvlei rivers, Vaal Dam and the main stem of the Vaal River downstream of Vaal Dam. 6. If a licence applicant from surface water is not in the Grootdraai Dam catchment and does not have direct access to transferred water because of the geographical location, then the conditions listed below applies. These are typically users from the other tributaries of the system i.e. Vals, Suikerbos, Klip, Renoster, Sand, Vet and Harts, to list some examples.

Situation Assessment: **(Continued)** **LICENSING**	a. Determine if the water is available from the local resource. b. If water is available, the full cost of the impact of the allocation on the yield of the system will be charged. The impact on the yield of the system will not be more than the total allocation. c. Water rights can also be obtained by means of trading as defined in the National Trading Policy. The need for the recipient, of a traded water use entitlement, to apply for a licence, depends on the particular conditions surrounding the donor and the recipient. If for example the trade is between irrigators receiving water from the same canal system, not new licence will be required. However, if the recipient is located on a river where other parties could be affected, a license is required. *Other general conditions are:* 1. Water quality impacts of any new license must be considered. 2. When the trading of water rights is considered, the net impact of the water users involved needs to be taken into consideration. The existing trading policy on in- sectoral trading should be applied. 3. New licences for abstractions from groundwater have to be evaluated can be allowed if it is found that the conditions pertaining to the specific water resource can support the demand.

MANAGEMENT ACTIONS (LICENSING)		
Required actions, responsibilities and priorities:	**M1**. Apply the guidelines and directive indicated above in the evaluation of new licences.	Regional Office (Priority 4)
Interfaces:	**References:**	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.3.3 PRICING

Management objective and motivation:	Apply the existing DWAF water pricing policy for water use in order to: (a) Maintain existing and develop new water supply infrastructure where necessary. (b) Sustain institutional capacity for effective management of the water resources of the Vaal River System. Furthermore, develop and implement waste discharge charges as a means of protecting the water resource quality by applying the polluter pays principle.
Situation Assessment:	DWAF has established a "Pricing Strategy for Raw Water User Charges" **[Ref. 1]** which sets out procedures for determining and implementing charges for water resource management, development of water infrastructure and charges for economic incentives and/or disincentives in order to promote the equitable and efficient allocation of water. The NWA provides an enforcement mechanism. With reference to the directives given in the "**LICENSINGA.3.2**" strategy, the pricing of water supply is an important mechanism to enhance the beneficial use of water and would help to contain the growth in water requirements in the Vaal River System. DWAF is currently developing a National Waste Discharge Charge System **[Ref. 2]** that will deals with return flows, tariffs, rebates, etc. and will be an economic mechanism to manage water discharges. Once the national system has been developed, tariffs will be determined for all the WMA catchments in the country. It is the intention to first develop and implement these waste discharge tariffs in pilot catchment areas before the scheme is applied in all WMAs. ***D**irectives, g**u**idelines or **r**equirements:* **R1.** New abstraction licences should be allowed at full cost in line with the appropriate tariff structures that are applicable in the specific supply system. **R2.** The need has been identified that some of the funds generated by the waste discharge charges in the Upper Vaal WMA should be allocated for the treatment of the water that is supplied to the users in the Middle and Lower Vaal WMAs. The pilot studies, referred to above, should be used to investigate such mechanisms. (*This requirement was identified after the document was circulated to all the DWAF officials*.)

MANAGEMENT ACTIONS (PRICING)		
Required actions, responsibilities and priorities:	**M1.** Develop and implement a Waste Discharge Charge System, first through application in pilot catchments followed by implementation in all WMAs. **{R2}**	Dir: WDD (Priority 2)

Interfaces:	**References:** **1.** DWAF report, "*A Pricing Strategy for Raw Water Use Charges*", November 1999. **2.** DWAF report, "*The Development of a Charge System for Discharging Waste into Water Resources*", Second Edition, May 2000. **3.** DWAF report, "*Water trading policy*", February 2001.

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A.4 WATER CONSERVATION AND DEMAND MANAGEMENT STRATEGY

Management objective:	To make more effective and efficient use of the existing available water resources in all water user sectors. The objective is to conserve water with the aim to avoid or delay the construction of further augmentation schemes. Furthermore, all water conservation and demand management programmes should implement measures that maintain the economic sustainability of all the institutions that are involved in water supply, especially the authorities at the different tiers of government.
Situation Assessment:	*Status Quo* **National Perspective:** The principles of Water Conservation and Demand Management (WCDM) are well entrenched in the National Water Act and DWAF is currently in the process of developing a national water conservation strategy. This initiative also includes the development of sectoral strategies that in some cases are backed by knowledge gained through pilot studies carried out in selected sectors. **Vaal River System Perspective:** The potential benefits of Water Conservation and Demand Management (WCDM) in the Vaal River System were illustrated in an assessment carried out during 1994 as part of the Vaal River Augmentation Planning Study (VAPS) **[Ref. 1]**. The results show that a reduction of about 10% in the projected water requirements would delay the proposed augmentation schemes and have an economic benefit of R4 billion (1994 prices) due to the delay in capital expenditure. This estimate excludes the savings that can be realised by postponing additional infrastructure to increase the capacities of bulk water treatment and distribution systems, which can easily be double the indicated benefit. It is important to note that this assessment was undertaken with the impact on return flows taken into consideration. There are currently various WCDM initiatives being implemented by water service providers and local authorities in the supply area of the Vaal River System. Furthermore WCDM is also being practised through the licencing and EMPR processes on mines and industrial complexes. In these sectors the reuse of effluent and polluted stormwater through recycling and treatment is being encouraged and has been implemented in a number of cases. Although these positive actions are taking place, what is lacking is reliable information on the combined effect these measures will have on the water requirements (current and projected) to be supplied from the Vaal River System. **[G1]** Due to this uncertainty, the water requirement scenarios produced by the NWRS did not consider the impact of WCDM measures and the water balance presented in the "**WATER BALANCE RECONCILIATION A.1.3**" strategy did not include the effect of WCDM.

Situation Assessment:

(Continued)

WATER CONSERVATION AND DEMAND MANAGEMENT STRATEGY

The following two WCDM planning initiatives were undertaken for the Vaal River System:

1. Gauteng Water Cycle Initiative led by representatives of Rand Water with the purpose of co-ordinating activities that have an impact on the water cycle. Activities of this initiative have declined due to resource limitations and the indication of surpluses in supply as described under the "**WATER BALANCE RECONCILIATION A.1.3**" strategy.
2. A study was commissioned by the then Directorate Water Conservation to assess Water Demand Management in the Vaal River System and Phase 1 (Development of a Study Framework) was completed during 2002. **[Ref. 2]**

Some factors to consider in planning for Water Conservation and Demand Management in the Vaal River System:

1. Cognisance should be taken of the impact of WCDM on the quantity of return flows with respect to the assessment of the net impact on the water resources. **[G2]**
2. The impact of WCDM on return flow volumes will alter the composition (blend of return flow sources) with the result that the water quality could be changed.
3. WCDM could, through reductions in return flows, impact on the river ecology and wetlands and these aspects should be assessed in all cases.

***D**irectives, g**u**idelines or **r**equirements:*

D1. This National and Sectoral strategies currently under development by the Directorate Water Use Efficiency must be applied in the Vaal River System.

D2. Notwithstanding the indicated conditional surplus in supply of Vaal River System, WCDM has other benefits and it is important that the awareness thereof should continue through initiatives such as the Water Cycle Management Initiative.

R1. Careful planning is required to ensure that cost recovery of water supply remains at levels that are viable, both to service providers and local authorities when implementing WCDM measures.

<table>
<tr><th colspan="3">MANAGEMENT ACTIONS
(WATER CONSERVATION AND DEMAND MANAGEMENT STRATEGY)</th></tr>
<tr><td rowspan="3">Required actions, responsibilities and priorities:</td><td>M1. Commission a WCDM Planning Study with the following objectives:
a. Assess the current and planned WCDM measures with the purpose of developing reliable estimates of the savings that can be expected.
b. Design and Implement a verification system to compare actual water use with projected water requirements to monitor the true effects of WC&WDM measures.
c. Undertake water resource modelling to determine the impact of WCDM on availability, quality as well as the flow requirements for the ecology.
d. Devise plans for the realisation of the National and Sectoral WCDM strategies in the Vaal River System.
e. Assess the impacts of WCDM on cost recovery with respect to the economic impacts on Local Authorities and Service Providers. {G2, D1}</td><td>Dir: WUE
Dir: NWRP
(Priority 2)</td></tr>
<tr><td>M2. Reactivate the Water Cycle Management initiative by:
a. Compiling a document motivating why WCDM still has significant benefits even if a potential surplus exists in the Vaal River System.
b. Creating awareness of the benefits of WCDM measures among Local Authorities as well as at the various Forums that are active in the Vaal River System. {D2}</td><td>Dir: WUE
(Priority 2)</td></tr>
<tr><td>M3. Develop a water demand and return flow model that can be used for scenario planning. The generic model developed from the Crocodile (West) River Return Flow Study [Ref. 3] should be used in this study. A large part of the study will involve collecting and collating the land use data to characterise the urban, irrigation and bulk users in the Vaal River System {G1}</td><td>Dir: NWRP
(Priority 2)</td></tr>
<tr><td>Interfaces:</td><td colspan="2">References:
1. DWAF report no: PC 000/00/15495, “Vaal Augmentation Planning Study: Water Demand Management in the Vaal River System Supply Area”. Compiled by BKS (Pty) Ltd, 1995.
2. DWAF report on the “Development of a Framework for Water Conservation and Demand Management in the Vaal River System”, 2001.
3. DWAF report no: PB A200/00/3802, “Crocodile (West) River Return Flow Analysis Study: Inception Report”, 2003.</td></tr>
</table>

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.5 INSTITUTIONAL DEVELOPMENT SUPPORT STRATEGY

A.5.1 INTERNATIONAL LEVEL

Management Perspective:	The **National Department** is responsible to draft and implement strategies and policies regarding international shared river basins. These strategies are guided by international protocols that define the basic framework for water management across international boarders. From a Vaal River System perspective, it will be required to communicate all issues relating to the international transfers through the appropriate National Department. The most important international connection that affects the Vaal River System is the Lesotho Highlands Water Project (LHWP), which transfers water from Lesotho.

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.5.2 CO-OPERATIVE GOVERNANCE

Management objective:	Co-operative governance (i.e. liaison and integration of planning between government departments, district and local authorities) needs to be factored into the overall integrated water resources management arena to ensure a compounded benefit to all users in the catchment. Proper management capacity at all levels of water resources management needs to be put in place in order to ensure that the water resource management process is adequately implemented.
Situation Assessment:	Certain water resource management functions remain with the Minister. Co-ordination at a national level will always remain necessary, especially at policy and regulation level. The Vaal River catchment is unique in that the Upper Vaal WMA receives water from other catchments such as the Thukela River and the Senqu River in Lesotho, while at the same time offering water to other catchments such as the Crocodile and Middle Vaal. The control and ownership of the water resource infrastructure in the Vaal River System also reside with different institutions and therefore requires a high degree of coordination of planning and operational activities. One of the most important planning variables is the future water requirements of users that will be supplied from the system. This is a subject that requires a high level of understanding among users, operators and the different authorities. The Department has the view that users must take responsibility for their own water demand scenarios, however, it is essential to have checks and balances, which is clearly a function of an Overarching nature. The Department has various co-operating management structures in place of which a few are listed below: ● Co-ordination with Eskom and Sasol with respect to the planning and operation of the Eastern Subsystem of the Vaal River System. ● Liaison with organised agriculture. ● Regular co-ordination activities with Rand Water. A Memorandum of Understanding is being prepared to guide the interactions and define the respective responsibilities of DWAF and Rand Water. ● Provincial Liaison Committees to co-ordinate, among other things, development planning that have an impact on the water resource in both the donor and recipient catchments. (As an example, it is essential to communicate with the Kwazulu Natal Provincial Government regarding the future planning and implementation of the proposed Thukela Water Project). ● Liaison between the DWAF National Directorates and the Regional Offices that are acting currently as the CMA for the three Vaal WMAs.

Situation Assessment: (Continued) **CO-OPERATIVE GOVERNANCE**	• Liaison with various Forums on regular intervals. This activity intensifies during drought periods when water restrictions are implemented. ***D**irectives, g**u**idelines or **r**equirements:* **R1**. There is a strong need to co-ordinate and encourage communications between the various government departments, regional and local authorities as well as the users receiving water from the Vaal River System. **R2.** Due to the national importance and the various transfers in and out of the Vaal River System, it is perceived that the National Department will continue to play a prominent role in the management of the Vaal River System.

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.6 WATER INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT STRATEGY

A.6.1 INFRASTRUCTURE DEVELOPMENT AND SUPPORT

Management objective:	Provision of adequate water resource development infrastructure (storage) and bulk water supply infrastructure to sustain a social and economic growth while protecting the environment.
Situation Assessment:	**General:** The local water resources in the Vaal River System were fully utilised many years ago through the development of a number of large dams to support the heavily industrialised and urbanised areas. Continuous economic and population growth in the supply area required additional augmentation, which was achieved through the construction of various transfer schemes (see the strategy on "**TRANSFERS AND RESERVATION OF WATER A.1.4** for details), mainly importing water directly into the Upper Vaal WMA. **Infrastructure development needs:** Based on the situation assessment presented in the "**WATER BALANCE RECONCILIATION A.1.3**" strategy, augmentation to the Vaal River System as a whole will only be required by 2025. The Eastern Sub-system of the Vaal River System, however, requires additional water resources by about the year 2010. **Existing knowledge on possible augmentation options:** 1. A pre-feasibility study to determine the need for augmentation of the Eastern Sub-system of the Vaal River System has been completed. This recommended that three options should be taken to the feasibility phase **[Ref. 1]**. 2. Current knowledge indicates that either Phase 2 of the Lesotho Highlands Water Project (LHWP) or the Thukela Water Project (TWP) would be the next augmentation option for the Vaal River System as a whole. 3. Planning status of the Thukela Water Project (TWP): A feasibility study on the TWP has been completed where it was identified that the Ecological Reserve is likely to have a significant impact on the size of the required infrastructure. This has led to the commissioning of the study to determine the Ecological Reserve of the Thukela River Catchment at a Comprehensive Level of detail. This latter study is almost completed and the intention is to undertake preliminary system analysis to show the impact of the proposed Reserve scenario on the supply capability of the proposed Jana and Mielietuin dams.

Situation Assessment: (Continued) **INFRASTRUCTURE DEVELOPMENT AND SUPPORT**	4. Planning status of Phase 2 of the LHWP: a. A pre-feasibility study has been completed as part of the Vaal Augmentation Planning Study. Further optimisation needs to take place before detail design can commence. ***D**irectives, g**u**idelines or **r**equirements:* **D1.** The interdependency of the WMAs of the Vaal River System, as well as other WMAs that are connected through the various transfers, make it essential that development planning be approached in a holistic manner. All planning effort will be required to identify the optimum bulk water storage and supply infrastructure that will make optimal use of the local and imported water resources. **D2.** In line with current planning methodology applied by DWAF, intervention by means of infrastructure development should only be considered once it has been proven that improved efficiency of water use through water conservation and demand management cannot satisfy the needs for augmentation. In all cases all potential augmentation options should be compared on the basis of economic, social, environmental and more specific ecological criteria in order to find the most feasible solution. **R1**. After completion of the Comprehensive Reserve Determination Study for the Thukela River Catchment, consolidate all planning information so as to allow further planning phases to proceed efficiently. **R2**. The programming of planning activities related to augmentation should constantly be adjusted based on the water reconciliation information to be produced by studies such as the Annual Operating Analysis. Continuous review of augmentation dates has to take place due to long lead times required for implementation of large water supply schemes.

MANAGEMENT ACTIONS (INFRASTRUCTURE DEVELOPMENT AND SUPPORT)		
Required actions, responsibilities and priorities:	**M1. Short-term actions:** a. Undertake a feasibility study and further planning activities to implement the augmentation of the Eastern Sub-systems of the Vaal River System. More details are provided in the **Upper Vaal ISP**. b. Complete the current Thukela Water Project Decision Support Phase with the aim of consolidating all planning information for later reference. **{R1}**	Dir: OA (Priority 1)
	M2. Continuous actions: Annual review of the required augmentation date should take place as part of the Annual Operating Analysis and the programme for augmentation planning need to be adjusted accordingly. **{R2}**	Dir: NWRP Continuous
	M3. Long-term actions: Based on the situation reflected by **Management Action M2,** activate the necessary planning actions to ensure timely implementation of the next augmentation scheme.	Dir: NWRP (Priority 4)
Interfaces:	**References:** **1.** DWAF report number PBC110/00/1200, "*Vaal River System: Pre-feasibility Study to determine the need for augmentation of the Eastern Sub-system*", 2002.	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.6.2 SYSTEM MANAGEMENT

Management objective:	Implement system management measures to optimally utilise the available water resources by reducing pumping costs during high runoff periods and implement beneficial water quality blending rules whilst maintaining the reliability of supply over the long-term.
Situation Assessment:	*Status Quo:* The Vaal River System is complex consisting of various water resource infrastructure components as presented schematically in **Figure B-2** of **Appendix B**. The system is intensely managed, particularly with respect to the main stem on the Vaal River as well as the operation of the Eastern Sub-system. The co-ordination of the system management activities is essential among the various institutions that are responsible for the operation of different components of the system (see also the "**CO-OPERATIVE GOVERNANCE A.5.2**"strategy**)**. Operations planning are undertaken on an annual basis where the following are considered: 1. Drought Management which include determining when and how intense restrictions should be implemented during drought events. This activity also entails communication with stakeholders and compliance monitoring to determine if the target reductions in demands are being achieved by the users. 2. Which blending or dilution operating rule should be applied with respect to the supply options to Rand Water and the release of water to maintain the TDS concentration to the desirable level to downstream users. 3. The reduction of pumping from the inter-basin transfer schemes as a means of reducing operating costs. 4. Communication of rules to operators and discuss operating options with main stakeholders. ***D**irectives, g**u**idelines or **r**equirements:* **R1.** Although drought management has been implemented in the past in the Vaal River System, the need has been identified for the formulation of a Drought Management Plan that defines all the actions and events that has to be considered in the period leading to and during a drought.

MANAGEMENT ACTIONS (SYSTEM MANAGEMENT)		
Required actions, responsibilities and priorities:	**M1**. Undertake annual operational planning to determine the operating rules to apply, as defined in the Situation Assessment Above.	Dir: NWRP Continuous
	M2. Develop and implement a Drought Management Plan. **{R1}**	Dir: NWRP (Priority 1)
Interfaces:	**References**	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.6.3 PUBLIC HEALTH AND SAFETY

Management objective:	At the overarching level the main management focus is on maintaining high levels of coordination among the Vaal WMAs with respect to flood and drought management. (Drought management has been addressed in the previous strategy.) The objectives with the strategy are therefore to co-ordinate and confirm the responsibilities for the management of the existing flood warning and management system.
Situation Assessment:	The Vaal River system has been subject to large floods and intense droughts in the past. The floods are a threat to human life and property. The existing warning and management system has proved itself in the past. The Department's current commitments are to manage floods by direct intervention on the ground. A sophisticated flood routing and dam optimisation/operation system has been developed for the Vaal River catchment. The system has been developed over a period of time and the operating rules are documented in a set of internal notes and operating manuals. Head Office staff at the Dir: Hydrological Information monitor the river system on a 24 hour basis and determine dam operation procedures (mainly Vaal Dam and Bloemhof Dam) when a potential flood hazard has been identified. Under these circumstances the Directorate of Hydrological Information directs the operation of the system for flood management. DWAFs (and the CMAs in some cases) future commitments under National Disaster Management Act which is to be promulgated in 2003 will be: • DWAF/CMA will be required to support and enforce disaster management planning by all relevant authorities. • Drafting a National Flood Management Policy and Dam safety policy is the responsibility of the Department. • Co-operating with the Department of Agriculture on drought relief strategies and policy formulation. • Managing the pollution of water resources (ie limiting health hazards such as cholera). Other relevant public health and safety strategies (i.e. pollution, dam safety) are described in the WMA specific ISP documents. ***D**irectives, g**u**idelines, **r**equirements or **g**aps:* **G1.** The operating rules and communication protocols for flood control are documented in a set of internal notes and operating manuals. These need to be assessed to determine if the current operating practice is adequately reflected in the manuals and notes and how well the protocols are understood by the staff based at the Vaal Dam. There is a need to ensure that the documentation is compiled in such a way to easily facilitate the transfer of the knowledge.

MANAGEMENT ACTIONS (PUBLIC HEALTH AND SAFETY)		
Required actions, responsibilities and priorities:	**M1.** The extent to which the roles and responsibilities of the staff involved in the flood management system are defined needs to be determined. The handing over of the operation from the regional person at the dam to the flood section in head office and the level of documentation, are particularly issues needing attention. Furthermore it is required to assess the current documentation with respect to its ability of facilitate knowledge transfer, with the aim to identify shortcomings and update where appropriate **{G1}**	Regional Offices (Priority 1)
Interfaces:	**References:**	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.7 MONITORING AND INFORMATION MANAGEMENT STRATEGY

A.7.1 MONITORING NETWORKS AND DATA CAPTURING

Management objective:	To design and implement effective monitoring networks and repository databases to ensure adequate quantification of the balance between sustainable water use and protection for surface freshwater bodies and groundwater.
Situation Assessment:	**Monitoring, for the purposes of this strategy, applies to all aspects of the water resource, particularly:** • Hydrology - rainfall, climate, and streamflow • Geohydrology – groundwater • Inflows and outflows (transfers) • Abstraction (water users, dam levels, operational releases, losses etc) • Water Quality (surface water, groundwater) • Waste water outflows • River Health (function and impact of the ecological Reserve) • Sedimentation **Supporting information includes:** • Small farm dams (numbers, capacity, use) – this will also require monitoring. • Land use change (agricultural cropping, forestry, alien invasives) – data available from other sources, but this needs monitoring. • Return flows *Key elements of the strategy*: To motivate **nationally** regarding the importance of monitoring and the essential need for better networks at national, WMA, and catchment level. The strategy is to ensure that those responsible for the allocation of funding fully understand that to allocate, manage and sell the water resource means that local managers need to know what and how much they have to allocate, manage and sell. • Coordination and cooperation across agencies at a regional level. • Organisational cooperation and efficiency. As an organisation the Department can only operate at optimum efficiency through close cooperation and sharing of relevant data capture and information management with its partners.

Situation Assessment: (Continued)

MONITORING NETWORKS AND DATA CAPTURING

- Assessment of information requirements (surface water, groundwater etc) at the scale of decisions (WMA and at catchment scale).
- Meetings and negotiations with cooperating partners. Assess what information is gathered, how it is processed and stored. Develop a plan for the sharing of mutually useful information.
- Together with cooperating partners develop a set of principles which outline the basis for monitoring and information capture. Typically these could cover: accuracy, completeness, time scales and time frames, information sharing)
- Prepare a set of standards for data capture and the processing of information.
- Design a monitoring system to meet needs. This design should offer phased implementation, based on priorities. Priorities should be broken down to critical monitoring points within specific fields of concern, so that the most urgent areas can be attended to first. Apply the cost: benefit principle.
- Motivate and seek funding to meet requirements
- Develop and train staff.
- At regional level the implementation of this monitoring strategy will be tasked to a small team drawn from across the traditional hydrological disciplines in the region.

Status Quo in the Vaal River WMAs:

An extensive monitoring network of flow gauges, rainfall stations and water quality sampling and analysis is in operation and has been used as the source of data for the water resource system analysis and water quality management studies. During these studies recommendations were made to upgrade the monitoring network, usually to fill a particular data deficiency that was identified for a specific analysis or application.

As part of the Vaal River System Analysis Update (VRSAU) study a report **[Ref. 1]** was compiled presenting the data that is required to undertake a system analysis study in the Vaal River System as well as recommending where the monitoring network could be improved.

What has been identified as a shortcoming is the definition of all the monitoring needs, and a co-ordinated monitoring programme in order to support the process of Integrated Water Resource Management, as defined in **Section 1.4** of this document.

Certain monitoring needs have been identified during the process of developing this ISP and are listed below for reference purposes. The purpose of providing the list is not to give an all inclusive definition of all the problems but to ensure that the identified items are recorded for use when **Management Action M1** of this strategy is implemented.

Situation Assessment: (Continued) **MONITORING NETWORKS AND DATA CAPTURING**	*Monitoring coordination and planning:* Coordination 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 feed to the WMA managers for coordination. 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. *List of some identified monitoring requirements for future reference:* **R1**. Uncertainty exists in the estimates of losses occurring in the bulk distribution network (conveyance losses) of the Vaal River System. Currently only rough estimates of the losses are available for use in the water resource models. It is recommended that these estimates are improved to model the actual conditions more accurately. **R2**. A general need was identified to improve and increase the flow measurement gauging stations in the system. Specific recommendations can be found in previous study reports, which will form the point of departure for the proposed study described under **Management Action M1**. **R3**. A national data management system should be maintained to capture and distribute data in support of water resource management functions. Such a management system is currently being developed by DWAF for use by all and controlled at a **National Level**.

MANAGEMENT ACTIONS (MONITORING NETWORKS AND DATA CAPTURING)		
Required actions, responsibilities and priorities:	**M1**. Undertake a study to assess, identify and recommend all monitoring requirements that are needed to support Integrated Water Resource Management. The Regional Offices will take the lead with support from other directorates and institutions. **{R1}**	Regional Offices (Priority 2)
	M2. Carry out a study to improve the estimates of conveyance losses in the bulk distribution network of the Vaal River System. It is anticipated that the emphasis of such an assessment will be where rivers are used for conduits with the losses in open canal systems as the second priority. **{R1}**	Dir: NWRP (Priority 1)
Interfaces:	**References:** **1.** Report number PC 000/00/19296 of DWAF, "Vaal River System Analysis Update: Data Inventory: Vaal Water Supply System Area", April 1999.	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.7.2 INFORMATION MANAGEMENT FOR WATER RESOURCE MODELLING

Management objective:	In order to base management decisions on reliable data and information management and decision support systems must be updated on a regular basis, be easily assessable.
Situation Assessment:	*Status Quo:* With reference to the situation assessment of the "**RESOURCE AVAILABILITYA.1.1**" strategy there are currently four main model and associated databases used in the Vaal River System as listed below: 1. Water Resources Simulation Model 2000 (WRSM2000) – This is a rainfall-runoff model with calibration features that is used to produce hydrological time series data. 2. Water Quality (TDS) Calibration model – Employed to calibrate the salinity sub-models using historical data. 3. Water Resource Yield Model (WRYM) – Water resource network simulation model used to determine operating rules and to determine the yield of the sub-systems of the Vaal River System. 3. Water Resources Planning Model (WRPM) – Integrates all the sub-system components that make up the Integrated Vaal River System and simulates both salinity and quantity operating rules. The WRPM is used to undertake development and operational planning, with distinguishing features such as a water allocation procedure, the ability to simulate dilution and blending rules and the simulation of changed system configurations and operating rules for a pre-defined planning horizon. The need for improvements to the models has been identified in previous studies. These recommended changes include among other increasing certain model dimensional constraints and the need for additional modelling functionality. **[R1]** It should be noted that the Directorate of Policy and Strategic Co-ordination has embarked on a model renewal process with the initial emphasis on improving the hydrological information management. To this end the Vaal Hydrological Information Management System (VHIMS) is currently being developed with the ultimate aim of providing a system that can manage all the data required by the models listed above.

MANAGEMENT ACTIONS (INFORMATION MANAGEMENT FOR WATER RESOURCE MODELLING)		
Required actions, responsibilities and priorities:	**M1**. Assess the need to improve the models using the identified shortcomings, and suggestions from previous studies, as a point of departure. The development of new functionality that will be required to undertake the challenges of Integrated Water Resource Management, as spelled out in **Section 1.4** of this document, should also be considered. **{R1}**	Dir: NWRP (Priority 2)
Interfaces:	**References: (none)**	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

A.8 IMPLEMENTATION STRATEGY

Management objective:	To ensure that the approaches put forward by the Department through this ISP are tadopted and implemented in the WMA. This will require willpower, funding and capacity.
Situation Assessment:	The ISP is an internal document, developed almost exclusively by and on behalf of the Department of Water Affairs and Forestry. The ISP sets out the approaches which the Department is taking towards water management in the Vaal River System – and lists suggested actions towards achieving good management of the water resource. The wider public has had no direct input into this ISP – yet it is recognised that the approaches adopted have a significant impact on the populace of the Vaal River System. Whilst the approach to date in developing this ISP may seem non-participatory, it must be remembered that this is not a Catchment Management Strategy – but DWAF setting out how DWAF itself sees the situation, and the steps which DWAF views as most appropriate in dealing with the situation. Years of interaction with the public have had an important influence. The ISP is not a closed document but is to be made available to the wider public for comment and input. This makes the ISP an inherently transparent document – exposing the thinking and planning of the Department. Although DWAF makes no commitment to adopt every comment made, these will be taken seriously and the ISP will be updated and improved as newer and better perspectives are formed. Once the CMA has been established it will be required to develop a CMS, and this will require full public participation. It is to be hoped that the ISP will be taken as useful baseline information and, indeed, that the approaches adopted here are found to be acceptable to, and adaptable by, the new dispensation. The ISP is subject to the approach set out in the NWRS – and details this approach for the Vaal River System. It carries significant weight in expressing HOW water resource planning and management will be carried out in the WMA. It is not, however, an inflexible document, nor is it without its flaws. As such the ISP may be adjusted and adapted when new and better ideas are presented.

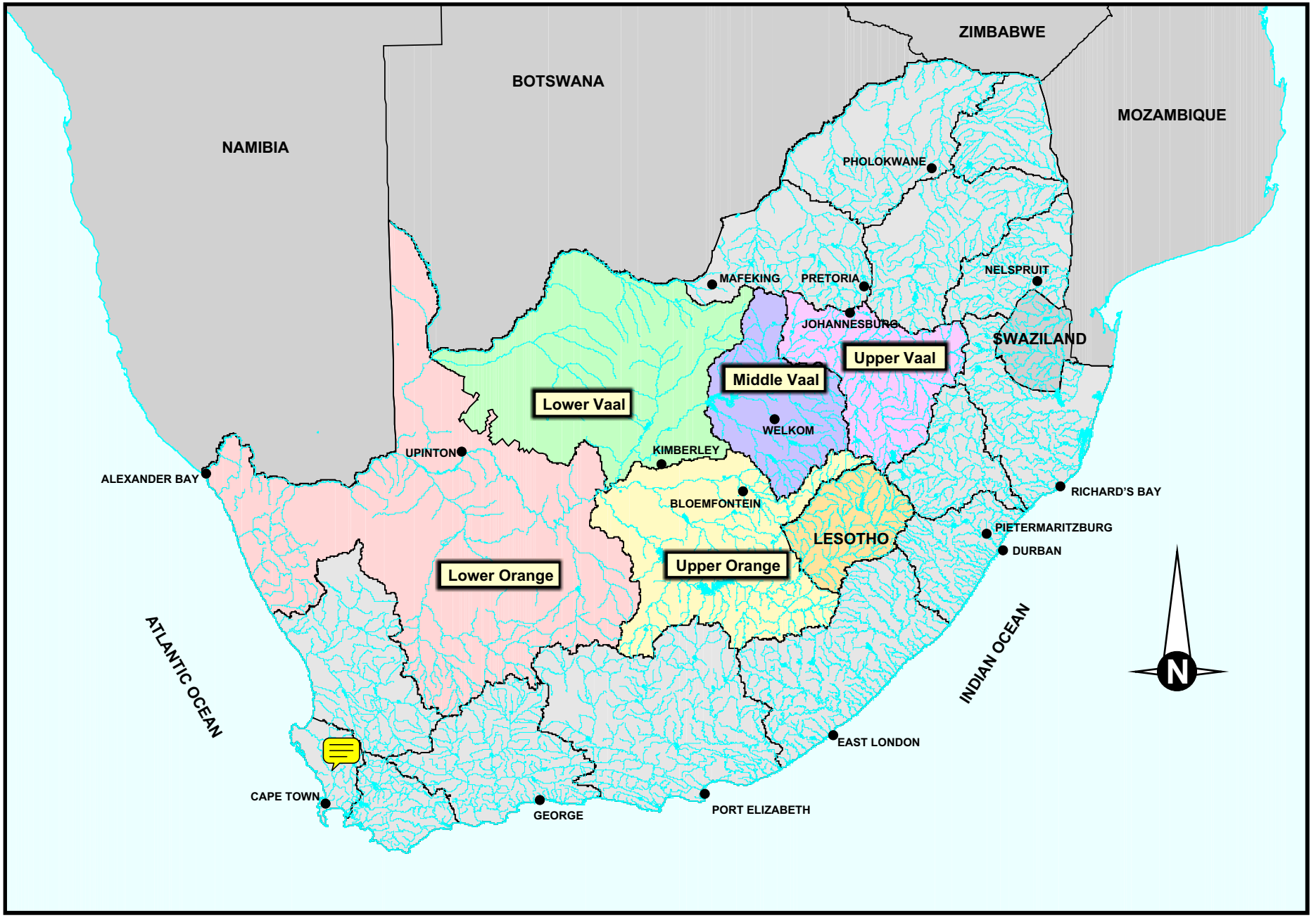
Situation Assessment: (Continued) **IMPLEMENTATION STRATEGY**	The Implementation of the ISP is an enormous task. Much of what is in this document describes the day-to-day functions of the Department – but there are many new tasks, functions, and actions set out in response to DWAF's visions for the future. It is recognised that it is quite impossible to immediately launch into, and achieve, all that is required by this ISP. Funds and capacity are, and will always be, blocks that must be climbed over. The approach is to take the ISP and to use it as instruction, guidance, and motivation in the development of yet clearer management and action plans. These must be built into Departmental Business Plans, and budgeted for as part of Departmental operating costs. This will necessarily be in a phased manner as dictated by available resources, but it is important that the ISP be used to leverage maximum funds, maximum capacity, and to bring optimum management to the WMA.

MANAGEMENT ACTIONS (IMPLEMENTATION STRATEGY)		
Required actions, responsibilities and priorities:	The following actions are required: a. Publish the ISP in hard-copy, on CD, and perhaps even on the Web, for public input and comment. Copies will only be presented to key stakeholders, and on request. It is not the intention to have a major drive for public input, but merely to create accessibility for input. b. There are many actions in the ISP which do require public involvement – and it is important that the thinking with regard to, for example, the use of groundwater, and the importance of WCDM, are taken out forcefully both to local authorities, other direct water users such as agriculture, and the wider public. c. Collate comment and consider this in revising and improving the ISP. d. There is a need to develop materials – suitable for the provincial cabinet, the various management committees, and major forums. Also to support the Water Services Development Plan, Organised Agriculture, Emerging Farmers, etc. This should be suited to make input to the preparation of the Provincial Growth and Development Strategy, and other regional and provincial planning activities. e. The ISP should, in any event, be open to continuous improvement, with possible updating on an annual basis. f. All Regional staff, Working for Water, (Rand Water, Eskom and Sasol), and other major stakeholders should have access to, or copies of, the ISP g. Approaches set out in the ISP need to be accepted and adopted by both national and regional staff. Where there is resistance to ideas then this needs to be resolved in an open climate of debate and understanding. Modification of the ISP is not ruled out! h. The practicalities of implementation demands must always be considered. Most actions in this ISP have been assigned to the Region. It is critically important that the tasks outlined are prioritised, budgeted for, and built into regional and national business plans and budgets.	

Strategy Version control:	**Version number:**	1
	Date:	March 2004
	Author:	ISP Study

Appendix B

Map and Schematic Diagram

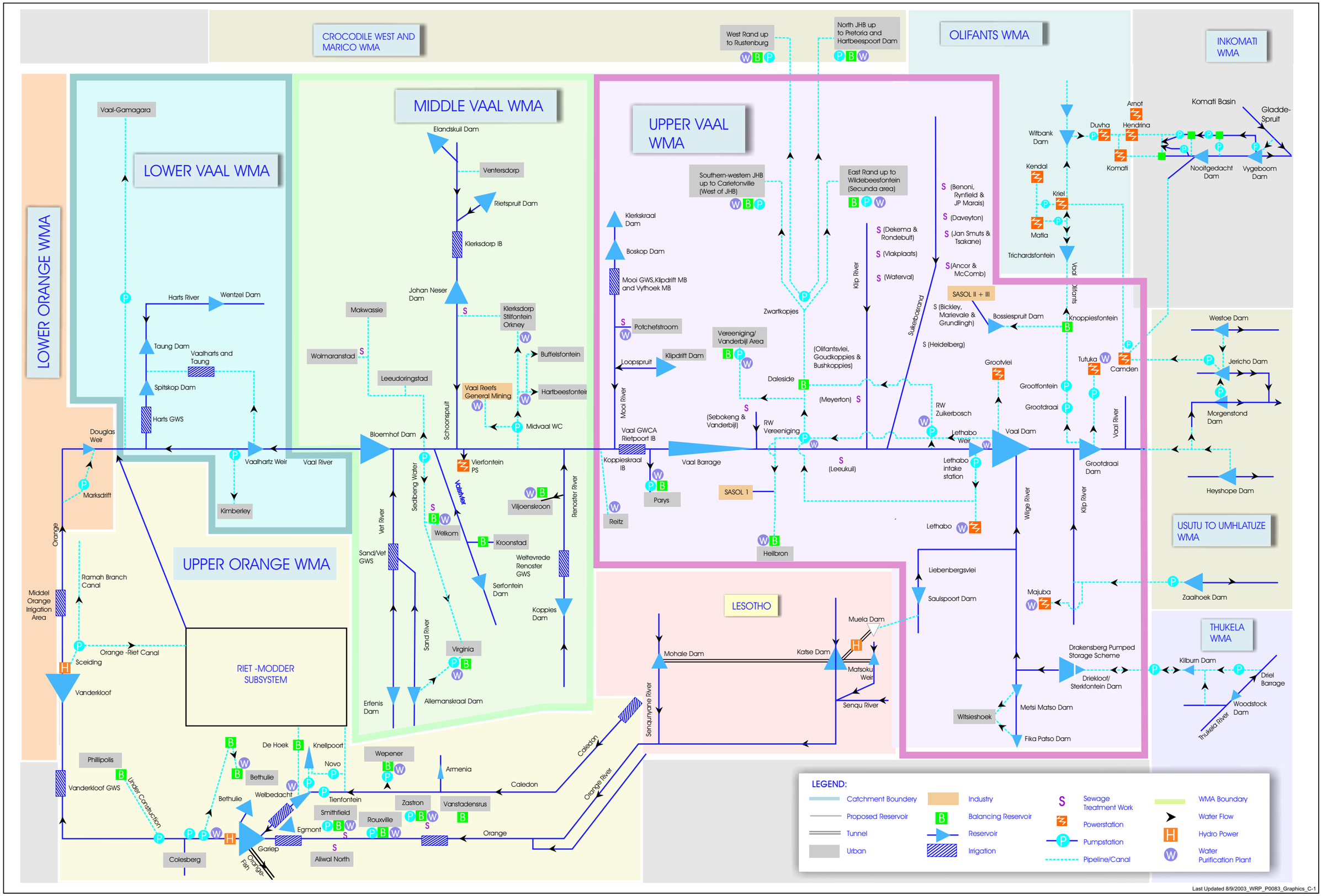


Last Updated 27/11/2003_WRP_P0083_Graphics_C-1

PDNA PD NAIDOO & ASSOCIATES

CENTRAL CLUSTER:
VAAL RIVER OVER ARCHING ISP

Locality Map B-1



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CENTRAL CLUSTER:
VAAL RIVER OVER ARCHING ISP

Schematic of the Integrated Vaal River System

B-2