



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

Internal Strategic Perspective

Upper Vaal Water Management Area



March 2004

COMPILED BY:



Department of Water Affairs and Forestry
Directorate National Water Resource Planning

INTERNAL STRATEGIC PERSPECTIVE
FOR THE
UPPER VAAL WATER MANAGEMENT AREA (WMA No 8)

APPROVAL

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Internal Strategic Perspective

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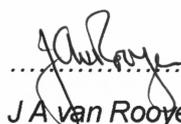
DEPARTMENT OF WATER AFFAIRS AND FORESTRY

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This report will be updated on a regular basis until it is eventually superseded by the Catchment Management Strategy.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

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

- Upper Vaal WMA Internal Strategic Perspective (*This Report*)
(Report No: P WMA 08/000/00/0304)
- 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)
- Vaal River System Overarching – Internal Strategic Perspective
(Report No P RSA C000/00/0103)
- The Upper Vaal WMA – Water Resources Situation Assessment
(Report No: P WMA 08/000/00/0301 and 08/000/00/0101)

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VERSION CONTROL

**UPPER VAAL WMA
INTERNAL STRATEGIC PERSPECTIVE**

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

EXECUTIVE SUMMARY

Introduction

The Internal Strategic Perspective (ISP) for the Upper Vaal Water Management Area (WMA) is described in this document, and represents the Department of Water Affairs' (DWA) view on how Integrated Water Resource Management (IWRM) should be practiced in the WMA.

The emphasis in this document is on aspects that are specific to the Upper Vaal WMA. The Upper Vaal WMA is part of a greater water supply system which includes a number of neighbouring WMAs and Lesotho. The strategies for IWRM for the greater system are presented in the Vaal Overarching ISP. The Upper Vaal ISP should be read in conjunction with the Vaal Overarching ISP to get a complete understanding of the strategies and issues.

The information in the report has been compiled from past studies, but more importantly, it captures the knowledge of DWA 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).

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 DWA to regularly update this document to keep the information and strategies relevant.

Overview of the Upper Vaal Water Management Area

The climatic conditions vary across the WMA, with the Mean Annual Precipitation (MAP) reducing from 800 mm in the headwaters to 500 mm at the Middle Vaal WMA boundary. This tendency is reversed when considering potential annual evaporation, which increases from 1300 mm in the Upper Vaal to 2800 mm in the West. 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 of the Vaal 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.

Due to the extensive development in the Vaal River System and in the Upper Vaal 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 transfer schemes

importing water from the Thukela and Usutu to Mhlathuze WMAs, as well as from the Kingdom of Lesotho through the Lesotho Highlands Water Project (LHWP).

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. Due to the interdependencies, the management and planning of the Vaal River System is undertaken at the national level and not by the Upper Vaal water managers (CMA when it is established, until then the DWAF Regional Office).

The Upper Vaal water managers will be responsible for the assessment of the availability of the local groundwater and surface water resources used to supply local authorities and district councils without access to the Vaal River System water supply infrastructure.

Water Requirements

The water requirement projections that are currently used for planning originate from the development of the National Water Resources Strategy (NWRS). The total water requirements in the Upper Vaal WMA is 2424 million m³/annum. The total water requirements for the Upper Vaal are projected to reach 2903 million m³/annum by the year 2025, for the base growth scenario.

Water Balance Reconciliation

The water balance for the Upper Vaal WMA indicates that for the year 2000, an overall surplus in supply of 19 million m³/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 m³/annum 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 m³/annum is projected for the year 2025 using the base 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. 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. 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 possible reconciliation options for the Vaal River System are dealt with in the Vaal Overarching ISP. The role of the Upper Vaal CMA will largely be Water Conservation and Demand Management (WC&DM), trading of water allocations and assisting with the water balances of the local authorities and district municipalities who are dependent on local resources for their supply and not the main water supply infrastructure supported by the Vaal River System.

Due to the relatively low growth rate of the projected water requirements (projected demand curve is relative flat) the impact of even small savings through WC&DM 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 WC&DM measures, the water balance calculations presented above do not allow for the impacts of WC&DM. This was identified as a gap in the current knowledge in the Vaal Overarching and a study is being proposed to collate all planning information on WC&DM. The targets for WC&DM will be set by the Vaal Overarching Study and the role of the Upper Vaal CMA will be to promote WC&DM and encourage the water service providers to achieve their targets.

*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 presented in more detail in **Strategy Table A.3.2** of **Appendix A**.*

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. This study has been prioritised as part of the Vaal Overarching ISP. The Upper Vaal CMA will have to revisit existing WQO and carry out future development of sub-catchment strategies within the framework of the Integrated Study.

Institutional Aspects

The role of the Upper Vaal CMA will include:

- *To manage the water quality by setting WQO and developing Catchment Management Strategy (CMS) as per the Water Quality Management Strategy. The setting of the WQO will be within the framework of the Integrated Water Quality Management Plan for the Vaal River Catchment (See details in **Strategy A2.2**).*
- *The monitoring of the system to provide management information for water quality management, abstraction control and input to the overarching operations and planning processes.*
- *Provide input into the supply of local authorities from local groundwater and surface water resources. This will be in the form of strategic level guidance as to where water can be obtained and the level of study needed to be submitted with the license application.*
- *A very important communication role between the Water Users and the Utility/DWAF Head Office.*
- *Promotion of WC&DM through the water service providers and Local Authorities/DWAF Head Office to achieve efficient use of water. Only once efficient use has been achieved can further augmentation be considered.*
- *Other delegated functions as determined during the process of establishing the CMA.*

Water Infrastructure Management

Due to the inter dependencies of the Vaal WMAs, the operation of the infrastructure has to be undertaken in a co-ordinated way to achieve the best efficiencies and balance potential, among stakeholders. This management will therefore be undertaken at the National level.

The Upper Vaal CMA may, depending on the findings of the planned Integrated Water Quality Study, be responsible for the management of treatment and reuse infrastructure for mine dewatering and sewage treatment plant return flows.

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.

The Upper Vaal water managers will be required to co-ordinate all the monitoring and information requirements within the WMA. This will include the compliance and other monitoring requirements of the WMA itself as well as the monitoring requirements of the Vaal River System to be used by the National body carrying out the overarching management.

ISP Implementation Strategy

The ISP is intended to act as DWAF's perspective on how the Upper Vaal WMA 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.

Internal Strategic Perspective for the Central Region : Upper Vaal Water Management Area (WMA 8)

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LIST OF ABBREVIATIONS

Acronym	Meaning
BP	Business Plan
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
Dir: HI	Directorate: Hydrological Information
Dir: NWRP	Directorate: National Water Resources Planning
Dir: OA	Directorate: Option Analysis
Dir: PSC	Directorate: Policy and Strategic Co-ordination
Dir: WRPS	Directorate: Water Resources 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 Project
IDP	Integrated Development Plan
ISP	Internal Strategic Perspective
IWRM	Integrated Water Resource Management
LHWP	Lesotho Highlands Water Project
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
NWA	National Water Act
NWRS	National Water Resource Strategy
WC	Water Conservation
WC&DM	Water Conservation and Demand Management
WDM	Water Demand Management
WMA	Water Management Area
WSDP	Water Services Development Plan
WQO	Water Quality Objectives
WRSAS	Water Resource Situation Assessment Study
WUA	Water User Association

CHAPTER 1: BACKGROUND TO THE UPPER VAAL WMA INTERNAL STRATEGIC PERSPECTIVE

1.1 LOCATION OF THE UPPER VAAL WMA

Figure 1.1 shows the location of the Upper Vaal WMA, which falls within the Gauteng, Free State, North West and Mpumalanga Provinces.

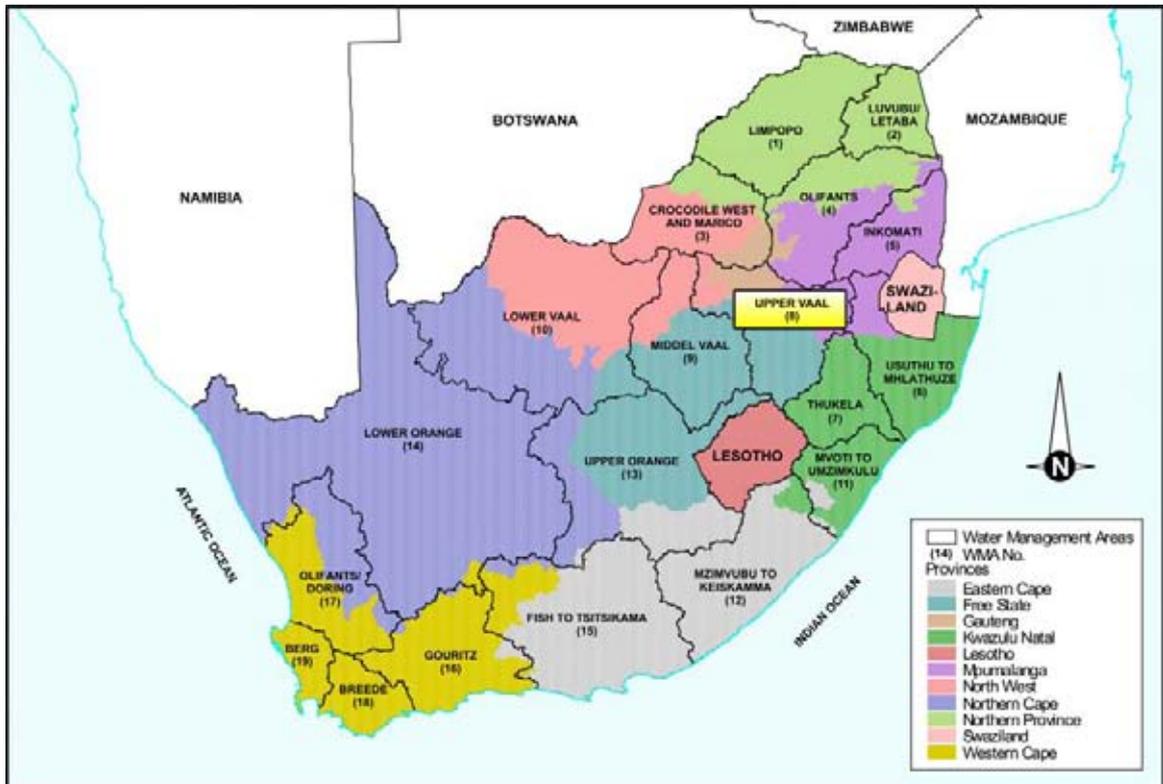


Figure 1.1: Location of the Upper Vaal WMA

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 Resources 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 (CMSs)

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.

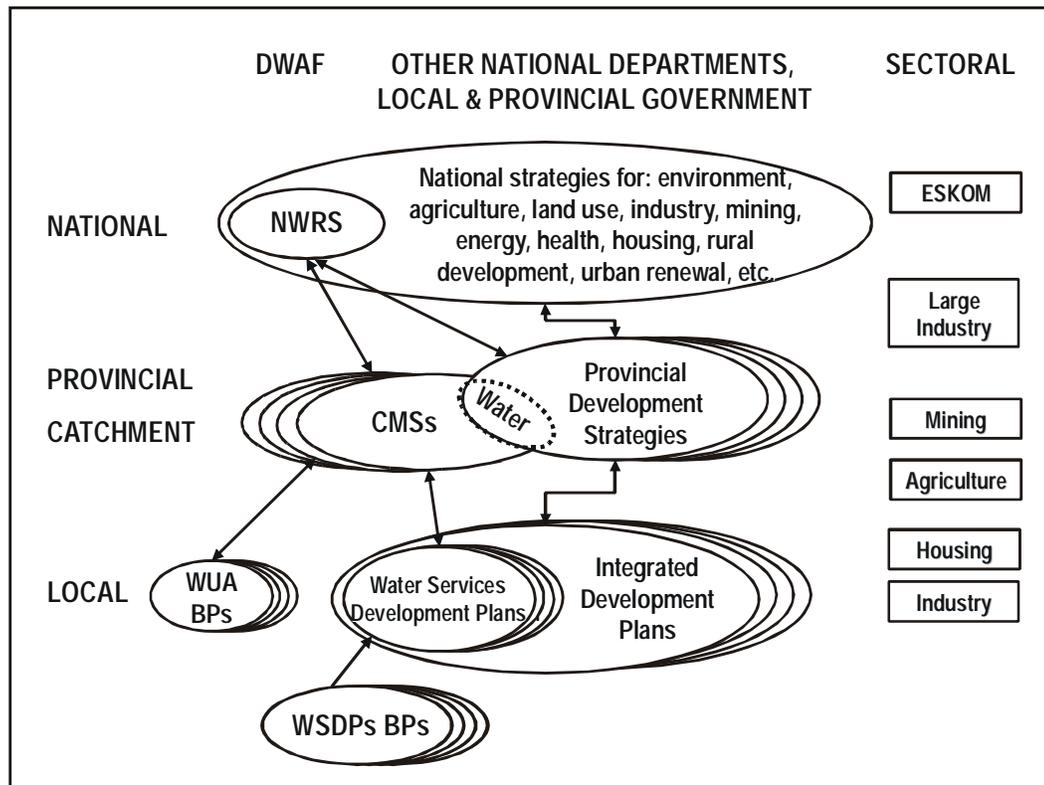


Figure 1.2 : Integrated planning approach at various levels of government in South Africa

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 detailed Water Management Area ISPs for the WMAs in the Central Planning Region were 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.

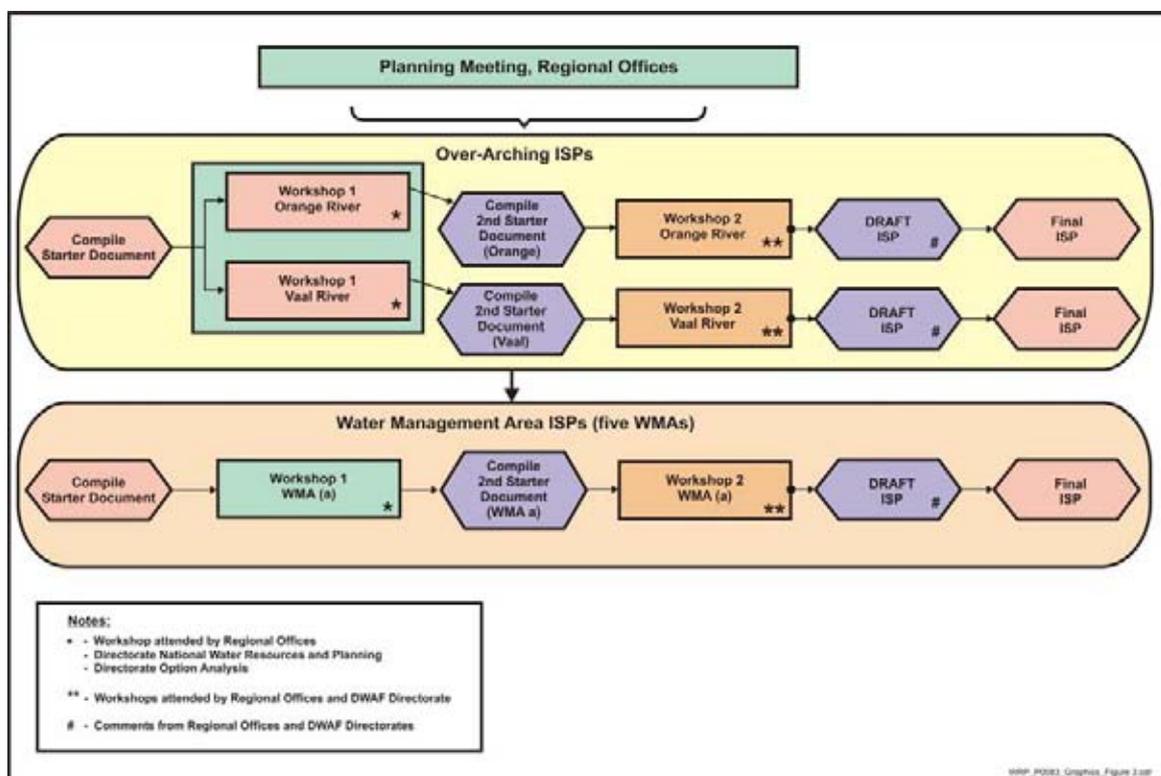


Figure 1.3 : Schematic showing ISP development process

The ISP for the Upper Vaal WMA was developed in five stages as follows:

- i) Determining the current status of water resource management and relevant water resource management issues and concerns in the Upper Vaal WMA. This was achieved through interviews with individual members of DWAF's RO in 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 Upper Vaal 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 (see Paragraph 1.5).

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 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 liaising 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 Vaal WMA. The current incumbent is Ms T Malaka, who has been delegated the task of managing version control.

1.3.4 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**.

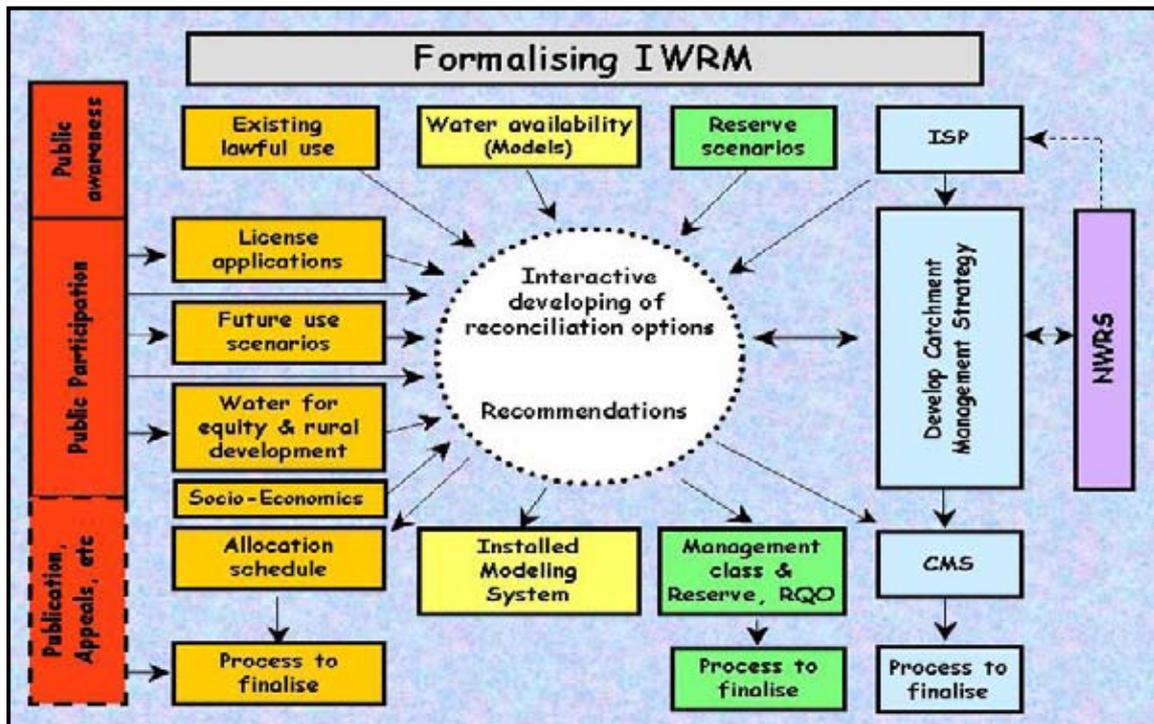


Figure 1.4: Diagram showing DWAF Integrated Water Resources Management approach

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.

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 (Part 2 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 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 (Part 2: Strategy no 10) 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 Brandvlei Dam for freshening the saline water in the lower reaches of the Breede River, 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 strategies 1.3, 2.2 and 3.2 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.

In this ISP refer to **Strategy 6.1**.

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.

CHAPTER 2 : BROAD PERSPECTIVE REGARDING THE WATER SITUATION IN THE UPPER VAAL WMA

2.1 INTRODUCTION

In this chapter summarised information from the National Water Resource Strategy (NWRS) (DWAF, 2004a) and the “Overview of Water Resources Availability and Utilisation” reports for the Upper Vaal WMA (DWAF, 2003a) is included to provide the reader with the required background of the water situation in the Upper Vaal WMA. When more detailed background information is required the reader is referred to the NWRS document and secondly to the “Overview of Water Resources Availability and Utilisation” reports for each WMA. These reports should in general provide sufficient detail for most readers. Even more detail can be obtained from the “Water Resources Situation Assessment Study” as prepared for each Water Management Area (DWAF, 2002).

The Upper Vaal WMA is part of a larger water supply system, which includes adjacent WMAs and Lesotho. This system is referred to in this document as the Vaal River system. A schematic of the system is shown in **Appendix B**. The Vaal Overarching ISP has been developed to deal with the strategies for this system. The Upper Vaal WMA is one of three WMAs in the Vaal River catchment, which is the drainage area of the Vaal River from its headwaters to the confluence of the Vaal and Orange Rivers. The Upper Vaal ISP should be read in conjunction with the Vaal Overarching ISP (DWAF, 2004b) to gain a complete understanding of the strategies for the WMA.

This chapter is structured to capture the background and related strategies for the Upper Vaal WMA in a logical and descriptive manner. A broad overview of the salient details that were identified in the Upper Vaal WMA workshops is also included. This will at the same time serve as an introduction to the detailed descriptions of the strategies that are presented in **Appendix A**. The tables in **Appendix A** present the strategies in a structured format which includes management objectives, background information in support of the motivation for the strategies, management actions that are required for the implementation as well as lists of related issues that were raised at the workshops or captured from study reports. The tables also contain cells to indicate the priority or relative importance of each strategy as well as which of the DWAF Directorates would be responsible for implementation.

In addition to the water resource system specific issues, listed in **Appendix A**, issues or strategies that were identified for consideration at national level are excluded from this document and will be dealt with through a separate document that will focus on all the National Issues. These items typically cover aspects that should be under the Minister’s control, relate to national policy, or were identified in several other WMAs and therefore require a high level of co-ordination.

2.2 GENERAL CATCHMENT DESCRIPTION

2.2.1 Overview

The Upper Vaal Water Management Area (Upper Vaal WMA) includes the Vaal, Klip, Wilge, Liebenbergsvlei and Mooi Rivers and extends to the confluence of the Mooi and

Vaal Rivers. It covers a catchment area of 55 565 km². This WMA includes the very important dams Vaal Dam, Grootdraai Dam and Sterkfontein Dam. The southern half of the WMA extends over the Free State, the north-east mainly falls within Mpumalanga and the northern and western parts in Gauteng and North West provinces respectively.

The Upper Vaal is the uppermost WMA in the Vaal River catchment and one of five WMAs in the Orange River Basin. It is surrounded by the Crocodile (West) and Marico, Olifants, Inkomati, Usutu to Mhlathuze, Thukela, Upper Orange and Middle Vaal WMAs and adjoins Lesotho in the southern extreme. (See **Figure 2.1**)

The NWRS describes and discusses the Upper Vaal WMA in three sub-areas viz the Vaal upstream of Vaal Dam, Wilge and the Vaal downstream of the Vaal Dam. The geographical extent of the sub-areas are shown in **Figure 2.1**. The broad overview of the water resource in the Upper Vaal WMA is discussed in terms of the NWRS sub-areas. A more detailed map showing the sub-areas and the main tributaries is given in **Appendix B**.

2.2.2 Topography

The Vaal catchment slopes gently from about 1 800 m in the east to 1 450 m in the west in the vicinity of the Vaal Barrage, with some steep areas in the headwaters of the Wilge tributary on the south-eastern border with the Orange. The water from the Upper Vaal WMA flows across the Middle Vaal, Lower Vaal and Lower Orange WMAs before reaching the Atlantic Ocean near the town of Alexander Bay in the western corner of the country. This cascading characteristic illustrates the interdependence of the indicated WMAs and emphasises the need for water resource management to take place across the WMA boundaries.

2.2.3 Geology and Soils

The area to the south of the Vaal River is underlain by fine sedimentary rocks of the Karoo system, as is the area to the north of the Vaal River, situated east of longitude 28° E. The Karoo system covers about 80 % of the Upper Vaal WMA. To the north of the Vaal River, west of longitude 28° E, igneous and metamorphic rocks predominate but there are extensive dolomitic exposures in the central areas which are mainly in the catchment of the Mooi tributary. More detail on the geology and geohydrology of the WMA can be found in the groundwater report given in **Appendix C**.

The predominant minerals are gold, uranium, base metals, semi-precious stones and industrial minerals. Gold mining, is of particular economic importance. Also of importance are uranium and coal mining. The mining of these minerals have implications in terms of water quality impacts.

Soil depths are generally moderate to deep with an undulating relief over the entire Upper Vaal WMA. There are three main soil types that predominate and these are distributed across the catchment as follows.

- Sandy Loam: In upper reaches of the Vaal and Wilge catchments and to north of the Vaal River along its central reaches.
- Clay Loam: In the Klip (Gauteng) and Suikerbosrand catchments and to the south of

the Vaal River along its central reaches.

- Clay Soil: In the middle and lower catchments of the Wilge and Vaal catchments upstream of Vaal Dam. It also occurs to the west of the Vaal .

2.2.4 Climate

The mean annual temperature ranges between 16°C in the west to 12°C in the east, with an average of about 15°C for the catchment as a whole. Maximum temperatures are experienced in January and minimum temperatures usually occur in July.

Rainfall is strongly seasonal with most rain occurring in the summer period (October to April). The peak rainfall months are December and January. Rainfall occurs generally as convective thunderstorms and is sometimes accompanied by hail. Frost occurs in winter and there is occasional light snow on high lying areas.

The overall feature of mean annual rainfall over the Upper Vaal WMA is that it decreases fairly uniformly westwards from the eastern escarpment regions across the central plateau area. The mean annual precipitation (MAP) for the watershed ranges from a high of 1 000 mm in the east to a low of 500 mm in the west with an average of about 700 mm.

Average potential mean annual gross evaporation (as measured by Class A-pan) ranges from 1 600 mm in the east to a high of 2 200 mm in the drier western parts. The highest Class A-pan monthly evaporation is in January (range 180 mm to 260 mm) and the lowest evaporation is in June (80 mm to 110 mm).

2.2.5 Vegetation

In this WMA the predominant veld type is “pure grassveld”. In the upper Wilge catchment and along the escarpment where the rainfall increases from about 700 mm to up to 1 000 mm there are areas of “temperate and transitional forest and scrub” while “false grassveld” predominates to the north of the Vaal River in its central reaches, particularly in the Mooi catchment.

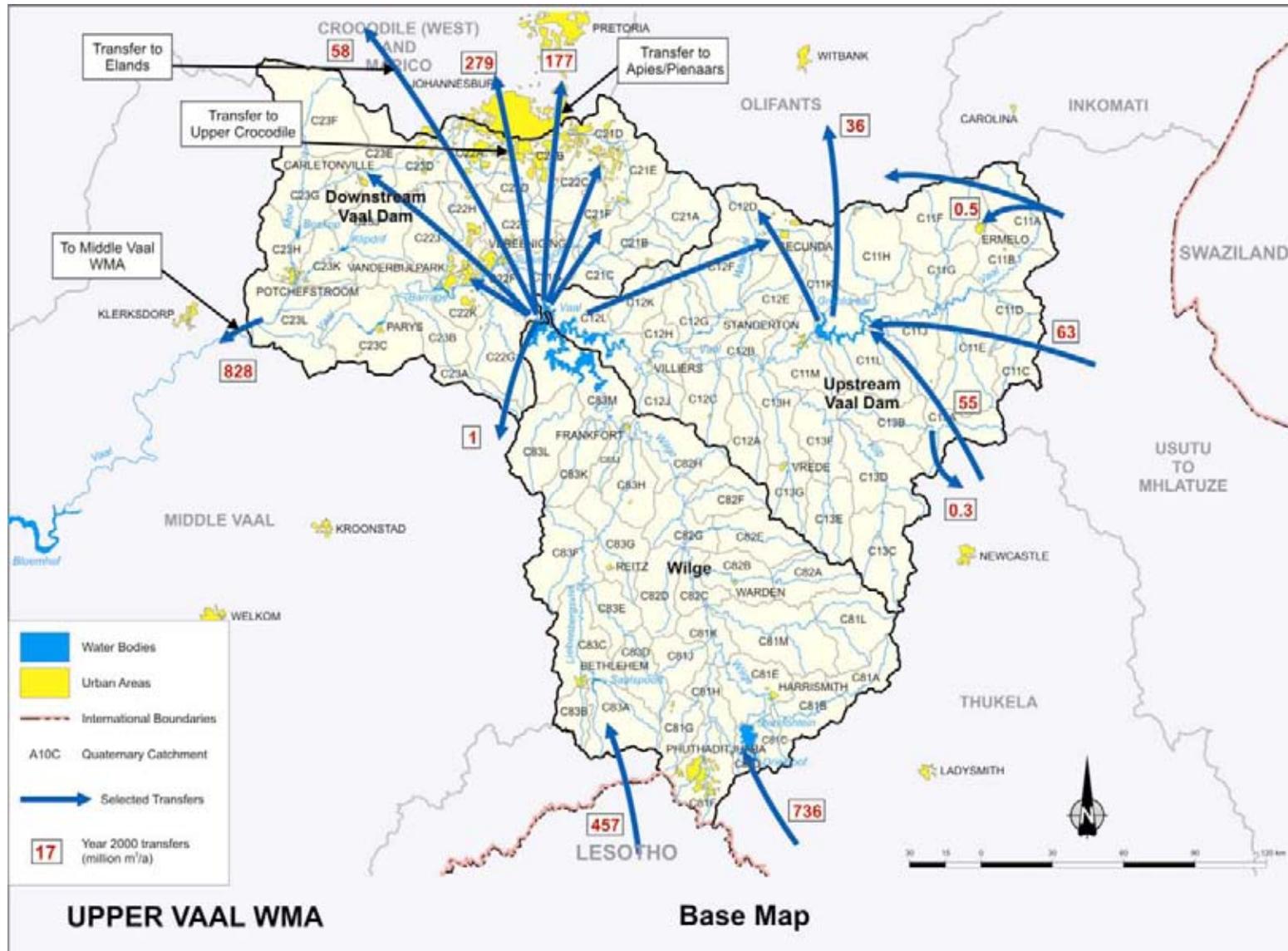


Figure 2.1 : Layout and location of the Upper Vaal WMA (Adapted from report number P WMA 08000/00/0203 entitled “Overview of Water Resources Availability and Utilisation” (DWAf, 2003a))

2.2.6 Environmentally Sensitive Areas

Ecologically sensitive areas identified in the Upper Vaal WMA include wetlands in the catchment of Suikerbosrand River, Klip (Free State) River and in the Wakkerstroom area of the WMA. The Blesbokspruit wetland in the Suikerbosrand catchment has been identified as a wetland of international importance as defined in the RAMSAR Convention. The Golden Gate National Park is located in the southern extreme of the WMA, while other conservation areas are scattered through the WMA.

2.2.7 Demography, Land Use and Development

The Upper Vaal WMA is the most populous WMA in South Africa. The total population is estimated at 5.6 million people in the year 1995. More than 80% of the population in the WMA reside in the area downstream of the Vaal Dam with nearly 97% living in an urban environment.

The demography of the WMA will be influenced by economic opportunities and potential. Projections are therefore for continued strong growth in urban population in the sub-area downstream of Vaal Dam where most of the economic activity is centred. A decline in population is projected for the Wilge sub-area due to the movement of people out of Phuthaditjaba and the former QwaQwa area.

Land use is dominated by cultivated dry land, which occurs throughout the catchment with high density areas in the Wilge and Vaal Dam to Vaal Barrage sub areas with the main crops being maize and wheat. The main dynamic land use activity in the catchment is the sprawling urban and industrial areas located in the northern and western parts of the WMA, which were historically established around the mining activities.

Products of the mining industry in the Upper Vaal WMA include coal, precious metals (gold, uranium, etc.), base metals, semi-precious stones and industrial minerals. The major impact of the mines on the water resource is the water pumped from the mines to dewater the underground workings mainly of the gold mines. The salinity loads associated with these mine discharges together with the sewage return flows contribute significantly to the salinity problems that are experienced in the Vaal Barrage and downstream river system. The mine dewatering and the diffuse salinity contributions from the highly developed urban and industrial areas in the Vaal Barrage catchment has resulted in the need for the currently applied blending and/or dilution operating rules applied downstream of Vaal Dam.

Major industries in this WMA include Sasol I (Sasolburg), Iscor, Sappi, AECI and Sasol Synthetic Fuels (SSF) (Secunda). Sasol I is located in the Free State province near Sasolburg and abstracts water from the Vaal Barrage. The production of petro-chemicals is the main activity. Iscor is located near Vanderbijlpark and is supplied with water from the Vaal Barrage. The production of iron and steel products is the main activity. SSF are located in Mpumalanga Province near the Secunda urban area. Water for SSF is supplied by pipeline from Grootdraai Dam. The production of petro-chemicals products is the main activity. Other important industries such as Sappi and AECI receive water from the urban centres where they are located. All these industries are economically

important and provide significant employment. There are three operational coal fired power stations located in the WMA. The power stations are the Lethabo, Tutuka and Majuba Power Stations.

The irrigation areas were estimated by Loxton Venn and Associates (LVA) in the report entitled "Report for the Vaal River Irrigation Study" (DWAF, 1999). Since the completion of the irrigation study, the registration of water use has been completed. Comparisons between the registered water use and the irrigation figures given in the report highlighted the uncertainties in the irrigation areas and water use, with the registered water use exceeding the LVA information. The verification process, which has been started in the WMA, will provide more certainty on the irrigation numbers.

About 75% of the irrigation is upstream of major storage dams and are supplied from run-of-river or farm dams. These areas will be supplied at a lower assurance of supply than the irrigation areas located in the Mooi sub-catchment (Mooi Government Water Scheme, Klipdrift and Vyfhoek Schemes) and Barrage to Mooi sub-catchment (Rietpoort and Koppieskraal Irrigation Boards) which are supported by major dams and conveyance infrastructure.

2.2.8 Economic Characterisation of the WMA

This WMA is economically one of the most important in the country and nearly 20% of the GDP of South Africa originates from the Upper Vaal WMA. Only the adjacent Crocodile(West) and Marico WMA, with about 24%, contributes more to the GDP. The contribution of the different sectors to the Gross Geographic Product (GGP) in the Upper Vaal WMA is shown in **Figure 2.2**. This reflects a diversified economy with a strong industrial and financial base. Despite the large areas under cultivation, agriculture only contributes about 2% of the GGP. Agriculture however has important linkages to other sectors and provides livelihood to a large proportion of the rural population.

The potential for future 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 mining developments will mainly replace worked out mines with a long term decline expected in this sector. There is however potential for further development of coal mining on the Eastern Highveld and in the Vereeniging area downstream of Vaal Dam.

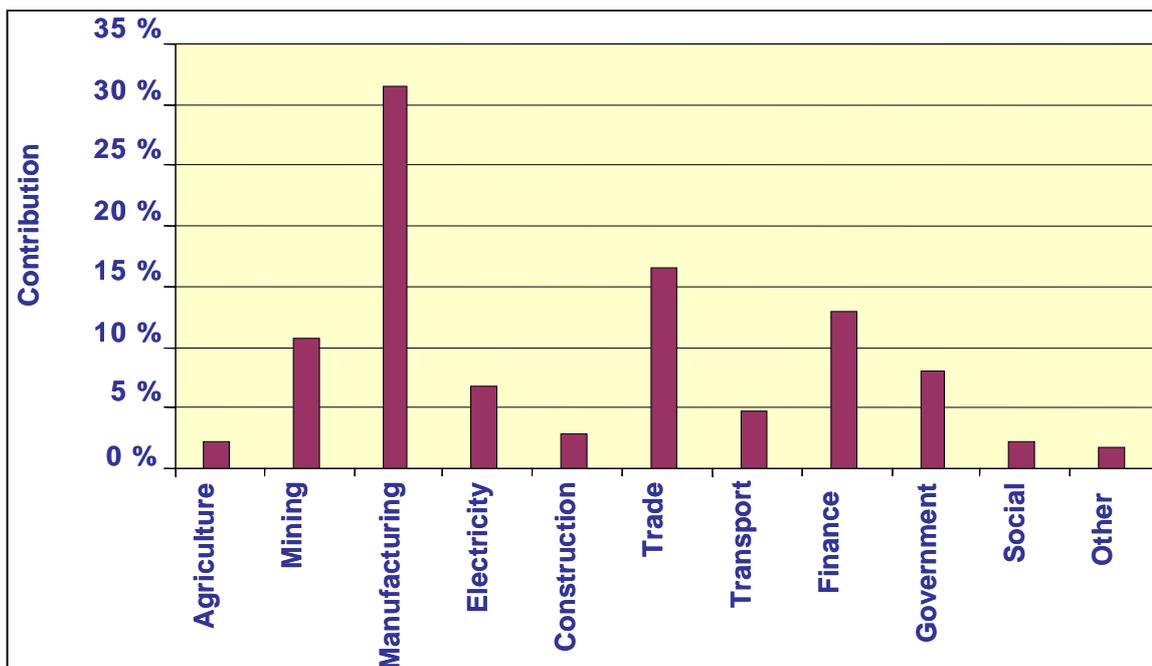


Figure 2.4 : Sectoral contribution to the GGP of Upper Vaal WMA (Taken from report number P WMA 08000/00/0203 entitled “Overview of Water Resources Availability and Utilisation” (DWAf, 2003a))

2.3 RESOURCE AVAILABILITY

2.3.1 Surface Water

The largest proportion (46%) of the surface flow in the water management area is contributed by the Vaal River upstream of Vaal Dam, together with its main tributary the Klip River. The Wilge River and the Liebenbergsvlei River contribute 36%, with the remaining 18% originating from the tributaries downstream of Vaal Dam. There are increases in runoff due to impermeable surfaces in urbanised areas. No significant afforestation occurs in the water management area. Numerous farm dams have also been built in the WMA, which negatively impact on the inflow to Vaal Dam. A summary of the natural mean annual runoff (MAR) per sub-area, together with estimated requirements for the ecological component of the Reserve, is given in **Table 2.1**.

It is important to note that the values for the mean annual runoff as well as the ecological component of the Reserve have been taken from national data sources, for the purpose of compatibility of the water management area information in the National Water Resource Strategy. In many instances more detailed studies have been conducted or are under way, from which improved information may be obtained (also on items other than the MAR and Reserve), and which should also be referred to with respect to detailed planning and design work.

Table 2.1: Natural Mean Annual Runoff and Ecological Reserve (million m³/a)

Sub-area	Natural MAR (1)	Ecological Reserve (1, 2)
Wilge	868	116
Upstream of Vaal Dam	1 109	126
Downstream of Vaal Dam	446	57
Total	2 423	299

1 Quantities given are incremental, and refer to the sub-area under consideration only.

2 Total volume given, based on preliminary estimates.

Naturally the quality of surface water in the water management area is good. However, the large quantities of urban and industrial effluent, together with urban wash-off and mine pumpage, have a major impact on the water quality in some tributary rivers in the north-western part of the water management area (e.g. Waterval, Blesbokspruit, Natalspruit and Klip). The Waterval River upstream of Vaal Dam, for example, contributes 2% of the water but 12% of the salinity load that reaches Vaal Dam. Similar situations also apply to some of the other tributaries. Coal mining activity in the Grootdraai Dam catchment is threatening the water quality of the dam.

The build-up of salinity in the Barrage is of particular importance and salinity concentrations in the water body need to be carefully managed to ensure that usability of the water is maintained for downstream users. Atmospheric pollution is also prevalent over parts of the water management area and contributes to the pollution of surface water resources.

The surface water naturally occurring in the WMA has been well developed through the construction of several large dams, and only limited potential for further development remains. The main storage dams are:

- Vaal Dam.
- Grootdraai Dam on the Vaal River upstream of Vaal Dam.
- Sterkfontein and Fika Patso Dams in the Wilge River catchment and Saulspoor on the Liebenbergvlei River, in the Wilge sub-area. Sterkfontein Dam is one of the largest dams in the country, and serves as a holding dam for water transferred from the Thukela water management area to the Vaal River System.
- The Vaal Barrage as well as Klerkskraal, Boskop and Klipdrif Dams are located in the sub-area downstream of Vaal Dam.

2.3.2 Groundwater

An important feature with regard to the groundwater resources of the Upper Vaal WMA is the large dolomitic aquifers which extend across the north-western part of the WMA. Much of the water in the Mooi River, which is known for its strong base flow, originates as springflow from these aquifers. Large quantities of water are also abstracted through pumping for urban use (such as by Rand Water) and for irrigation. As a result of the direct connections between the dolomitic aquifers and surface streams, increases in groundwater abstraction will result in corresponding decreases in surface flow. Dewatering of the dolomitic compartment can also result in the formation of sink holes.

Extensive de-watering of dolomitic compartments for mining purposes, has taken place in the north-west of the WMA where gold ore underlies dolomitic formations. This resulted in temporary increases in surface flow while water tables were being lowered. Reductions in surface flow which may last several years, will be experienced when mine pumping is stopped and the compartments are allowed to fill again.

The remainder of the WMA is mainly underlain by fractured rock aquifers, which are well utilised for rural domestic water supplies and stock watering. Although of specific importance in some areas, only 3% of the total water requirements in the water management area are supplied from groundwater.

The quality of groundwater is generally of a very high standard. Due to chemical reaction when groundwater infiltrates into mine caverns, poor quality water often results which can cause serious pollution when water decants or seeps from such mines.

A detailed report on the groundwater in the WMA is given in **Appendix C**.

2.3.3 Transfers

Large quantities of water are transferred into the water management area to augment the local resources (See **Figure 2.1**). The total yield transferred into the Upper Vaal water management area amounts to the equivalent of more than 120% of the yield from local surface resources, while virtually the same quantity is again transferred (or released) out of the water management area. Transfers into the Upper Vaal water management area are from the Usutu to Mhlatuze and Thukela water management areas, as well as from the Senqu (Orange) River in Lesotho. The water transferred from other water management areas is generally of good quality and lowers the salinity and turbidity of water in Vaal Dam. Transfers out of the water management area are to the Crocodile (West) and Marico, and Olifants WMAs and through releases along the Vaal River to the Middle Vaal and Lower Vaal WMAs. From a water management perspective, the Upper Vaal WMA is in a pivotal position in the country. Through the extensive transfers of water into and out of the WMA, water management in the Upper Vaal WMA impacts on flow volume, flow regime and water quality in all the surrounding WMAs and Lesotho.

2.3.4 Summary (Resource Availability)

The total water available for use in the Upper Vaal WMA at the year 2000 development levels is summarised in **Table 2.2**.

In total, over 54% of the current available water in the water management area is supplied through transfers from other water management areas and Lesotho. Also noticeable is the re-use of return flows, which constitute 21% of the available water, with the remainder being supplied from surface and groundwater resources naturally occurring in the WMA.

Table 2.2: Available water in year 2000 (million m³/a) (Taken from DWAF (2003a))

Sub-area	Natural resource		Usable return flow			Total local yield (1)	Transfers in	Grand Total
	Surface Water	Ground-Water	Irrigation	Urban	Mining and bulk			
Wilge	46	4	2	7	0	59	0	59
Upstream of Vaal Dam	154	8	3	11	8	184	118	302
Downstream of Vaal Dam	399	20	7	325	138	889	1 224	2 113
Total	599	32	12	343	146	1 132	1 310	2 442

1 After allowance for the impacts on yield of: ecological component of Reserve, river losses, alien vegetation, rain-fed agriculture and urban runoff.

2.4 WATER REQUIREMENTS

2.4.1 Current requirements (year 2000)

Reflecting the predominantly industrialised nature of the economy in the WMA, 77% of the WMA requirements for water is by the urban, industrial and mining sectors; with 11% for irrigation, 8% for power generation and the remaining 4% for rural water supplies. Geographically, over 73% of the total requirements for water is in the sub-area downstream of Vaal Dam and nearly 20% in the sub-area upstream of Vaal Dam, which again corresponds to the concentration of development and economic activity in these regions. Most of the irrigation in the water management area is in the sub-area downstream of Vaal Dam, with a large proportion of the irrigation water supplied from urban return flows and from dolomitic aquifers (as groundwater or surface flow). A summary of the sectoral water requirements (year 2000) in each of the sub-areas is given in **Table 2.3**. All the requirements are given at a standard 98% assurance of supply.

Evident from **Figure 2.1** are the large quantities of water transferred out of the WMA, and which are largely destined for urban, industrial and mining use as well as for power generation in neighbouring water management areas.

In the Wilge key area, about half of the water requirements is for urban use (mainly at Bethlehem, Harrismith and Phuthaditjhaba), with the remainder split between rural use (domestic and livestock) and irrigation. Most of the water requirements in the Grootdraai to Vaal Dam sub-area upstream of Vaal Dam are for mining and bulk industrial use (coal mines and the Sasol petro-chemical complex), with substantial portions also for urban use and power generation. Downstream of Vaal Dam the urban requirements for water are dominant and, although proportionately small, large quantities are also used for mining and large industries as well as irrigation and power generation.

A substantial proportion of water used in the urban and industrial sectors is used non-consumptively and becomes available again as effluent. At the larger centres, most or all of the effluent is discharged back to the rivers after appropriate treatment, from where it can potentially be re-used. Nearly 50% of the urban water use in the key areas downstream of Vaal Dam is re-used in this way, much of which via the Barrage. Effluent

from smaller towns typically evaporates from maturation ponds, or may be taken up by irrigation and infiltration.

Table 2.3: Year 2000 water requirements (million m³/a) (Taken from DWAF (2003a))

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Affore- station (4)	Total local require- ments	Transfers out	Grand Total
Wilge	18	27	15	0	0	0	60	0	60
Upstream of Vaal Dam	29	32	17	99	39	0	216	67	283
Downstream of Vaal Dam	67	576	11	74	41	0	769	1 343	2 112
Total	114	635	43	173	80	0	1 045	1 379	2 424

1 Includes component of Reserve for basic human needs at 25 ℓ/c/d.

2 Mining and bulk industrial water uses which are not part of urban systems.

3 Includes water for thermal power generation only. (Water for hydropower generally is available for other uses as well.)

4 Quantities given refer to impact on yield only.

2.4.2 Future requirements

There are many factors, which influence the requirements for water. These include climate, nature of the economy (i.e. irrigated agriculture, industrialised) and standards of living. Of these, climate is relatively stable, while in most cases control can be exercised over the growth in irrigation water requirements. Population and economic activity, however, have their own inherent growth rates which are dependent on a wide spectrum of extraneous influences. Population growth and economic growth, which also relates to socio-economic standards, are therefore regarded as the primary determinants with respect to future water requirements.

Based on the scenarios for population and economic growth, initial estimates of possible future water requirements were made for the period until 2025 (DWAF, 2001). In addition, provision was made for known and probable future developments with respect to power generation, irrigation, mining and bulk users as described under the respective sub-areas where applicable. (Specific quantities, rather than a general annual growth rate, were allowed for in these sectors.)

Within the spectrum of population and economic growth scenarios, a base scenario was selected for estimating the most likely future water requirements. This is built on the high scenario of population growth and more equitable distribution of wealth leading in time to higher average levels of water services. The ratio of domestic to public and business (commercial, communal, industrial) water use for urban centres in the year 1995, for the respective centres, is maintained. A possible upper scenario of future water requirements, is also given, based on the assumption that there will be high population growth and a high standard of services (socio-economic development); together with a strong increase in the economic requirements for water, where the public and business use of water would increase in direct proportion to the gross domestic product. The purpose of the upper scenario is to provide a conservative indicator in order to prevent the occurrence of possible unexpected water shortages. No

adjustments have been made for reflecting the impacts of increased water use efficiency.

General trends in the Upper Vaal WMA are continued concentration of economic development in the Johannesburg-Vereeniging-Vanderbijlpark area and increasing urbanisation of the population. A strong growth in water requirements can therefore be expected in the sub-area downstream of Vaal Dam. Similar growth is also expected in the urban and industrial requirements for water in the Crocodile (West) and Marico WMAs, which is largely dependent on Upper Vaal WMA for its water. Large quantities of additional water will therefore have to be transferred. Additional water will also be required in the sub-area upstream of Vaal Dam, related to growth in the petro-chemical industries and increasing generation of power in the region.

Apart from some decline at Phuthaditjhaba, no meaningful change in the requirements for water is foreseen in Wilge sub-area and the rural parts in the other sub-areas.

Quantification of the projected future requirements for water is presented in **Tables 2.4 and 2.5** for the base and high scenarios respectively.

**Table 2.4: Year 2025 base scenario water requirements (million m³/a)
(Taken from DWAF (2003a))**

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Affore- station (4)	Total local requireme nts	Transfers out	Grand Total
Wilge	18	25	13	0	0	0	56	0	56
Upstream of Vaal Dam	29	36	17	99	75	0	256	74	330
Downstream of Vaal Dam	67	763	10	74	43	0	957	1 561	2 518
Total	114	824	40	173	118	0	1 269	1 634	2 903

- 1 Includes component of Reserve for basic human needs at 25 l/c/d.
- 2 Mining and bulk industrial water uses which are not part of urban systems.
- 3 Includes water for thermal power generation only. (Water for hydropower generally is available for other uses as well.)
- 4 Quantities given refer to impact on yield only.

**Table 2.5 : Year 2025 high scenario water requirements (million m³/a)
(Taken from DWAF (2003a))**

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Affore- station (4)	Total local requireme nts	Transfers out	Grand Total
Wilge	18	47	13	0	0	0	78	0	78
Upstream of Vaal Dam	29	52	17	99	75	0	272	74	346
Downstream of Vaal Dam	67	1197	10	74	43	0	1 391	2 067	3 458
Total	114	1 296	40	173	118	0	1 741	2 140	3 881

1 Includes component of Reserve for basic human needs at 25 l/c/d.

2 Mining and bulk industrial water uses which are not part of urban systems.

3 Includes water for thermal power generation only. (Water for hydropower generally is available for other uses as well.)

4 Quantities given refer to impact on yield only.

The water requirement projections show a low growth over the next 25 years. This implies that small changes may have large impacts on implementation dates for new reconciliation options. If the water requirements are higher than the projections the implementation dates will move forward conversely if higher efficiencies are achieved the augmentation dates may be delayed by several years.

It is therefore important that the water requirements be monitored and compared to projections on an ongoing basis, particularly those made by Rand Water. Agreement will have to be reached with water service providers on future scenarios as they have a major impact on implementation dates.

2.5 WATER BALANCE

2.5.1 Year 2000 Water Balance

A reconciliation of available water and total requirements for the year 2000, including transfers between WMAs is given in **Table 2.6** and **Table 2.7**. In **Table 2.6** the balance is given without the inclusion of the yield of the Mohale Dam while **Table 2.7** gives the balance including the yield of Mohale Dam. The balance in **Table 2.7** uses the year 2000 water requirements but the water availability includes Mohale Dam completed in 2003.

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. The quantity transferred will thus increase over time in line with the growth in the water requirements.

**Table 2.6: Reconciliation of requirements and available water for year 2000
(million m³/a) (without yield of Mohale Dam)**

Sub-area	Available water			Water requirements			Balance (1)
	Local Yield	Transfers in (2)	Total	Local requirements	Transfers out (2)	Total	
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	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.

**Table 2.7: Reconciliation of requirements and available water for year 2000
(million m³/a) (with yield of Mohale Dam)**

Sub-area	Available water			Water requirements			Balance (1)
	Local Yield	Transfers in (2)	Total	Local requirements	Transfers out (2)	Total	
Wilge	59	0	59	60	0	60	(1)
Upstream of Vaal Dam	184	118	302	216	67	283	19
Downstream of Vaal Dam	889	1 544	2 433	769	1 343	2 112	1
Total	1 132	1 630	2 763	1 045	1 379	2 424	339

- 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.

The marginal deficit shown with respect to the Wilge sub-area is attributable to the provision made for the Reserve, which is still to be implemented. Without the provisions for the Reserve, a small surplus exists in this sub-area.

2.5.2 Future Water Balances

A perspective on the possible future water balance situation is given in **Table 2.7** for the base scenario, and **Table 2.8** as representative of possible high water use scenario. In both cases transfers into the water management area have been increased to reflect the additional yield available from the commissioning of Mohale Dam in Lesotho. The increased need for transfers out of the sub-area upstream of Vaal Dam is to meet the growing water requirements for power generation in the Olifants WMA, while increased transfers are required from the sub-area downstream of Vaal Dam to augment supplies to the Pretoria-Johannesburg metropolitan area, in the Crocodile (West) and Marico

WMA. (Reference may also be made to the ISP reports on the Crocodile (West) and Marico, and Olifants WMAs.) However, for the high scenario, the projected deficit is 765 million m³ which is 20% of the total water requirement. If the high scenario is realized, a scheme will have to be implemented well before 2025.

No dramatic change in water requirements is foreseen in the Wilge sub-area. Growth in this part of the water management area is likely to be concentrated around the main towns of Bethlehem and Harrismith, with a decline expected at Phuthaditjhaba.

The Grootdraai Dam catchment is predicted to have a deficit by 2010 despite there being a conditional surplus in the Vaal River Catchment until 2025. This is due to the location of Grootdraai Dam in the upper reaches of the WMA. Access to the water transferred from outside the WMA is through Vaal Dam. Several options for the possible further development of surface resources have been investigated as part of the Eastern Vaal Subsystem Analysis (DWAF, 2002). Amongst the feasible options was a dam on the Klip River (Free State) or a pipeline from Vaal Dam to Trichardtsfontein Dam. The analysis showed that the dam on the Klip River (Free State) merely shifted yield that would have been realized at Vaal Dam to the upper areas of the WMA where the shortfalls occur. The yield shifted from Vaal Dam will be made by transfers into the WMA. The decision to opt for the pipeline option from Vaal Dam has been taken in principle.

Table 2.8: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Sub-area	Available water			Water requirements			Balance (3)
	Local yield (1)	Transfers in	Total	Local requirements (2)	Transfers Out	Total	
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	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.

Table 2.9: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Sub-area	Available water			Water requirements			Balance (3)
	Local yield (1)	Transfers in	Total	Local requirements (2)	Transfers out	Total	
Wilge	64	0	64	78	0	78	(14)
Upstream of Vaal Dam	190	118	308	272	74	346	(38)
Downstream of Vaal Dam	1 232	1 513	2 745	1 391	2 067	3 458	(713)
Total	1 486	1 630	3 116	1 741	2 140	3 881	(765)

- 1 Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from growth in requirements.
- 2 Based on high growth in water requirements as a result of population growth and high impact of economic development. Assumed no general increase in irrigation.
- 3 Brackets around numbers indicate negative balance.

2.6 WATER RECONCILIATION OPTIONS

2.6.1 Allocation of Conditional Surplus

The water reconciliation situation in the Upper Vaal WMA is one of a conditional surplus until 2025. The future schemes needed to augment the water resources of the Upper Vaal WMA will largely be decided at the National Level with the development of the next augmentation scheme. The management of the surplus is discussed in more detail in the Vaal Overarching ISP.

2.6.2 Intervention Measures

The options that can be considered within the WMA are :-

- The implementation of Water Conservation and Demand Management (WC&DM). The water requirements that are used in the development of the WMA water balance do not include WC&DM. A study quantifying the reduction in the water requirements, return flow volumes and the changes in return flow water quality of implementing WC&DM has been identified and prioritised in the Vaal Overarching ISP. However Regional Office/CMA must play an active role together with the Water Service providers such as Rand Water in the WMA to ensure the implementation of WC&DM.
- Trading of water allocations between users.
- Further development of the local water resource in particular groundwater to meet local water requirements. In this process the impact on the yield of system must be determined and the reduction in yield must be covered at full cost as this will have to be replaced with transferred water.
- Compulsory licencing can also be used to achieve a water reconciliation in a WMA. At this stage, with the conditional surplus there is no immediate need to implement compulsory licencing in the WMA.

2.6.3 Necessity for Compulsory Licencing

Given that there is a conditional surplus, there is no immediate need for compulsory

licencing in the Upper Vaal Wma. Some issues (See **Compulsory Licencing Strategy A1.6**) were raised at the ISP workshops. The approach to be adopted in addressing these issues is to fully understand the issues and to use the available regulations and communication with the water users to resolve the issues.

2.7 WATER QUALITY MANAGEMENT

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 interim WQO are based on the water quality guidelines and the water uses as well as the ecology. The subsequent phases in the process, following the situation assessment step, are to develop water quality management plans or sub-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 Interim 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 approach described above involves the setting of WQO and the development of water quality management plans in isolation for each of the identified sub-catchments. This approach does not address the issue of impacts of WQO set and management actions on downstream water quality requirements. To address this, the need for an Integrated Water Quality Management Plan for the Vaal River Catchment was identified. The priority and responsibility of drawing up the terms of reference have been assigned as part of the Vaal Overarching ISP.

Many of the water quality management issues revolve around the management of closed, current and future mining. The mining activities are threatening the water quality of a number of the sub-catchments. In particular the water quality of the Grootdraai Dam is under threat from the current mining activities. There are large further coal reserves that can still be exploited which will put even greater pressure on the water quality of the dam. In addressing the water quality impacts and implication of mining in the WMA, the Department is going to have to communicate with the DME through the EMPR process. Good co-operative governance is essential to the management of mining.

Large volumes of water are returned to the river system from the urban areas via sewage treatment plants. These discharges pose a threat to the water quality of the surface water resources of the Upper Vaal WMA in particular as far as nutrients are concerned. The management of these discharges through the licencing process is essential. The management and impacts of nutrients will also be addressed during the development of the Integrated Water Quality Management Plan for the Vaal River Catchment.

2.8 INFRASTRUCTURE SYSTEM MANAGEMENT

There is a well established set of hydrological and water use databases as well as water resource analysis models available for the analysis of the Vaal River System. Annual operating runs are undertaken using the models and decisions made on system operation. The description of these systems is given in the Vaal Overarching ISP. These

models are run at the national level with the decisions being passed to the Upper Vaal WMA for implementation.

The local infrastructure that the Upper Vaal CMA may have to run in the future are the treatment plants and collection systems for the mine dewatering and the treatment/re-use options as far as the management of sewage treatment plant discharges are concerned. The future of these schemes will be decided as part of the Integrated Water Quality Study for the Vaal River Catchment.

2.9 MONITORING AND INFORMATION SYSTEMS

The Upper Vaal water managers will be required to co-ordinate all the monitoring and information requirements within the WMA. This will include the compliance and other monitoring requirements of the WMA itself as well as the monitoring requirements of the Vaal River System to be used by the National body carrying out the overarching management.

2.10 INSTITUTIONAL ASPECTS

The Upper Vaal WMA is part of a larger supply system, which includes adjacent WMAs and Lesotho. The Upper Vaal WMA acts as a conduit for most of the transfers into the Vaal River Catchment to other WMAs such as the Olifants, Middle Vaal, Lower Vaal and Crocodile (West) and Marico WMAs. Due to these interdependencies, the operations and planning of the Vaal River catchment will not be undertaken by the Upper Vaal CMA or Regional Office but at the national level by the Department's Head Office or a utility that may be established to undertake these tasks. The management at this level is described in the Vaal Overarching ISP and includes Water Reconciliation and Water Quality Strategies.

The role of the Upper Vaal CMA will include:

- To manage the water quality by setting WQOs and developing CMS as per the Water Quality Management Strategy. The setting of the WQOs will be within the framework of the Integrated Water Quality Management Plan for the Vaal River Catchment (See details in Strategy A2.2).
- The monitoring of the system to provide management information for water quality management, abstraction control and input to the overarching operations and planning processes.
- Provide input into the supply of local authorities from local groundwater and surface water resources. This will be in the form of strategic level guidance as to where water can be obtained and the level of study needed to be submitted with the license application.
- A very important communication role between the Water Users and the utility/DWAF Head Office.
- Promotion of WC&DM through the water service providers and local authorities/DWAF Head Office to achieve efficient use of water. Only once efficient use has been achieved can further transfers be considered.
- Other delegated functions as determined during the process of establishing the CMA.

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Appendix A
Strategy Tables

Upper Vaal Water Management Area Strategies

INTRODUCTION TO 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).

Some issues are clearly applicable to all WMAs in the country and for some a national policy to guide the strategy needs to be developed first. These issues and aspects were identified and flagged for consideration at **National Level**.

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.
Management action (M)	Solutions to fill in information gaps, adhere to directives and to meet requirements.

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A.1 WATER BALANCE AND WATER RESOURCE RECONCILIATION STRATEGIES

A.1.1 RESOURCE AVAILABILITY

<p>Management objective:</p>	<p>Ensure that reliable estimates of the water resources (surface and groundwater) are available to effectively conduct Integrated Water Resources Management. The factors impacting on the water resources needs to be clearly defined and understood.</p>
<p>Situation Assessment:</p>	<p>Surface water resources:</p> <p>The Upper Vaal WMA is a component of the extended Vaal River System for which an integrated system’s model has been compiled to account for the complex inter -dependencies resulting from the various inter-basin transfers (Ref-1). This model is currently used to assess and manage the available water resources using the Water Resource Planning Model (WRPM). (More detail on the surface water availability is provided in the Resource Availability Strategy A1.1 in the Vaal Overarching ISP).</p> <p>The application of the WRPM and maintenance of the associated database systems will be undertaken at the national level. The management of the overall system will deal with the available water resources that can be used to supply water users with direct access to water systems linked to the main water supply infrastructure. The role of the managers of the Upper Vaal WMA will then be in assessing the available surface water resources in unregulated areas of the WMA. In all instances, the impact of the development of the water resource in the tributaries should be assessed on the system as a whole. These local water resources are used to supply the water requirements of users (mainly small towns) that do not have direct access to the water from the main river system and may therefore be supplied at a lower assurance.</p> <p>The surface water resource availability in the unregulated catchments in the WMA is not well quantified. More detailed (higher resolution) hydrological analyses and monitoring of the resources are required to better assess the availability of water in these areas to meet the local water requirements. The responsibility for the development of these resources will be vested with the local use such as a local authority. The role of the Department would be to provide strategic level input into the process with respect to where water could be available and the effect on the yield of the system.</p> <p>As shown in Tables 2.2, the return flows in the WMA represent a significant portion (44%) of the total local yield. The biggest portion of the return flows is from the urban sector in the form of sewage treatment plant discharges. There is also a substantial volume of mine dewatering returned to the river system. This water can contain high levels of dissolved salts which limits its usability.</p>

<p>Situation Assessment: (Continued)</p>	<p>The impact on the water resource availability in terms of water quality is an important issue that is discussed in more detail in the Water Quality Management Strategy A2.2.</p> <p>The projected return flow volumes and qualities currently used in the systems models, do not account for the implementation of WC&DM, possible direct re-use and changes in the mine dewatering regime. The impacts of these factors on the return flow volumes and qualities need to be determined by means of a return flow analysis study. Such a study is discussed in more detail in the Vaal Overarching ISP in the Resource Availability Strategy A1.1.</p> <p>The mine dewatering in the catchment of Boskop Dam in the Mooi sub-catchment has a significant impact on the water resources that are available from the dam. Without the mine water, Potchefstroom town (supplied from Boskop Dam) would require additional water resources. The monitoring of the mine discharges, the volumes conveyed in the water infrastructure and the river flows is inadequate to estimate the water balance with confidence. Clarity is needed on the future planned discharges from the mines for water resource planning purposes.</p> <p>Groundwater resources:</p> <p>Groundwater is used in the WMA largely for irrigation and domestic use particularly on the dolomites, which are located in the Mooi sub-catchment (For more information on the groundwater in the Upper Vaal WMA see the groundwater report in Appendix C). There is uncertainty about the groundwater availability (exploitable volume not contributing to surface base flow) in the WMA. Although the exact quantity of the exploitable groundwater and the groundwater use is uncertain, groundwater represents a large potential resource particularly for local supply in areas that are distant from the main river system. Boreholes are also used in the extensive urban areas in the WMA typically for garden watering. The extent of this use and the impact on the groundwater resource is not known.</p> <p>There is also extensive dewatering of the groundwater resource to allow mining to take place. The water pumped from underground is used on the mines or discharged to a water course where it forms part of the return flow volume. The mine dewatering can reduce the surface flows significantly if the link between the groundwater and surface water systems is strong. In the dolomitic areas of the WMA such as the Mooi River catchment, the dewatering has reduced the surface flows by drying up some of the natural springs in the area. The spring flow that occurred naturally is replaced by the mine dewatering discharge. These discharges therefore form an important part of the available water in the system with downstream users often reliant on the discharges as a source of supply. Some of the mines will start closing down in the near future and the mine workings will be rewatered. The rewatering program needs to be carefully planned in terms of future location of decant points, decant volumes and water quality as well as the impact on the downstream water users. The rewatering program must be planned so that the assurance of supply of the downstream users is not affected.</p>
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Situation Assessment: (Continued)	Due to the fact that the availability of groundwater is largely dependent on localised sub-surface characteristics, estimates of the potential of the resource should be area specific. It is therefore recommended that the need for data on the availability of groundwater be driven by the need for water in particular areas. Any application for the use of groundwater must be accompanied by a first order study showing that the impact on the water resource is acceptable.
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MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	<p>M1. The hydrological models and methodologies that should be applied to address the resource availability in the unregulated areas of the catchment will be developed during a pilot study to be undertaken on the Mhlathuze River catchment. These more rigorous models and methodologies should be used to analyse the resource availability of areas that are experiencing problems or where new licence applications need to be evaluated.</p>	Ad hoc basis Regional Office and Dir. NWRP (Priority 3)
	<p>M2. A study needs to be done on the WMA to determine the impact of WC&DM on the return flow volumes and qualities as well as the water requirement projections. The study should produce a model, which can be used to predict the discharge volumes and qualities for WC&DM in the different water use sectors. The model results should be compared against actual return flow and water requirement figures achieved using WC&DM. Water service providers will be approached to assist with the collection and provision of the information for the study. (For further information see Resource Availability Strategy A1.1 in the Vaal Overarching ISP)</p>	Dir. NWRP (Priority 1)
	<p>M3. Quantify the interaction between groundwater and surface water in areas where problems have been identified. (This task will only be considered once the methodology (technology) is available from the relevant National Strategy)</p>	Ad Hoc (Priority 3)
	<p>M4. A groundwater availability map should be produced for the WMA. The map should be used to identify areas where groundwater is available to meet local demands and give estimates of the volume of groundwater that is available to meet water requirements. If a higher degree of confidence is required in certain areas more rigorous analysis should be undertaken. Groundwater quality map should also be considered. The outcome of M3 should be used as input to this activity.</p>	Dir. WRPS (Priority 1)

Required actions, responsibilities and priorities: (Continued)	M5. Before any detailed analysis is carried out, the extent of the groundwater use in urban areas must be assessed to enable an initial assessment of the impact on the resource to be undertaken.	Dir. WRPS (Priority 3)
	M6. A return flow management plan should be developed to manage the sewage return and mine dewatering flows proposed by the dischargers. The intention of the plan is to identify opportunities for re-use by high value users. A typical example would be locating a treatment plant or a mine dewatering point close to a re-use opportunity.	Regional office (Priority 1)
	M7. The water resource availability in Boskop Dam should be revisited using all the available data to confirm the current situation. If it is found that the existing data and monitoring is insufficient to obtain a reliable water balance, investigations should be made to expand the monitoring network. Once the monitoring data becomes available, the water availability should be updated and appropriate water management actions taken if necessary. The interaction between the surface and groundwater flows and the dolomitic compartments is being addressed in a groundwater study to be initiated shortly. A strategy to rewater of the dewatered compartments will be developed in this study.	Regional Office (Priority 1)
Interfaces:	References: 1. DWAF report no : PC000/00/18496 "Vaal River System Analysis Update : Integrated Vaal River System Analysis:	

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A.1.2 WATER REQUIREMENTS

Management objective:	Ensure that the knowledge base on the water requirements in the WMA is realistic and updated on a regular basis. Furthermore, maintain and update water requirement projection scenarios for planning and management purposes.
Situation Assessment:	<p>Water use data:</p> <p>The actual water use data are collated from the different DWAF offices and bulk users on an annual basis and is currently captured in a spreadsheet database. The management and application of the water requirement data collected is discussed in the Vaal Overarching ISP report. More information on the water requirements can be found in the Vaal Overarching ISP and in Section 2.5 of this report.</p> <p>Registration and verification of water use:</p> <p>The registration process has been largely completed and indications are that the registered use for irrigation is much higher than the currently accepted estimates (Ref 1). The process of verification of existing lawful use is in progress. If the verification process confirms the registered irrigation water use then this will have serious implications for the water balance for the WMA. Once the verification has been completed, it will be essential to compare the verified water use with the current estimates.</p> <p>Water requirement scenarios:</p> <p>The water requirement scenarios currently used for planning originate from the National Water Resources Strategy. The approach to be followed is presented in Water Requirement Strategy A1.2 in the Vaal Overarching ISP and the salient points are summarised below :-</p> <ul style="list-style-type: none"> • The "Ratio Method" is used to determine the most probable future scenario for the urban sector. 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 requirements into the future (Ref 2). • The water users remain responsible for determining their water requirements. The Department has developed an approach to making water requirement projections based on population as the main driver and the per capita water demand. The per capita demand will be based on the socio economic standing of the users. The projections must also account for WC&DM and provide estimates of return flows. The Department is to communicate the methodology to the water users. • The main bulk users such as Rand Water, Eskom and Sasol provide water requirements on an annual basis. These projections are compared with previous scenarios to determine the level of deviation as well as possible changes in trends. Comparisons of these projections are made with the NWRS projection and adjustments are made where appropriate, mainly over the short term.

Situation Assessment: (Continued)	<p>The general approach is to maintain the long term future projections as was defined in the NWRS and only make adjustments over the short term. The intention is that the NWRS projections will be updated at about five year intervals. These updates account for national trends in demography and economics.</p> <p>The water requirements of the smaller users not included in the Rand Water projections will be obtained by the Upper Vaal CMA through the WSDP and water use licence applications.</p>
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MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	<p>M1. The process of verification of existing lawful use should be completed. Comparisons should be made between the lawful use and the water use data applied in the water resource system models and the models should be updated if necessary.</p>	Regional Office (Priority 1)
	<p>M2. The current practise of annual updates of water use and water requirement projections should be continued and comparisons made with the larger consumer projections.</p>	Dir. NWRP (Priority 2)
	<p>M3. The Department must communicate the roles of the users and the Department in making water requirement projections. The methodology developed by DWAF must also be promoted with the users.</p>	Dir. NWRP and Users (Priority 2)
Interfaces:	<p>References:</p> <ol style="list-style-type: none"> DWAF report no : PC000/00/21599, "Report for the Vaal River Irrigation Study", September 1999. 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. 	

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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) by applying the priorities defined in the National Water Act, ensure equitable sharing of the water as well as making specific allocations for poverty eradication initiatives.
Situation Assessment:	<p>Overall water balance situation (Integrated Vaal River System) (see also Vaal Overarching Report):</p> <p>The Upper Vaal WMA as a component of the extended Vaal River System has been the subject of various studies in the past (Ref 1). The details of the water balance reconciliation in the WMA in terms of the supply to those users with access to the main stem are discussed in the Vaal Overarching ISP. The salient points made in the Vaal Overarching ISP are listed below. For details it is recommended that the Vaal Overarching ISP be consulted.</p> <ul style="list-style-type: none"> • With Phase 1B of the LHWP in place, there is a conditional surplus of 339 million m³, which is estimated to be able to supply the projected water requirements until 2025. • It is important to note that the current 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. In practice, the volume of water conveyed through the Thukela-Vaal Transfer scheme will be reduced to save pumping costs thus effectively operating the system to balance the water demands with the supply. • Despite the conditional surplus, additional augmentation is required for the Eastern Sub-systems (Ref 2) consisting of Grootdraai Dam and supporting systems. Pre-feasibility studies investigating possible future supply options have been undertaken. Subsequent to these studies, Eskom has indicated that a pipeline transferring water from Vaal Dam would be the preferred option. • Based on the conditional surplus, water requirements of new users can be accommodated, however, the full cost of making the water available will be charged. <p>Water Balance Perspective in the Upper Vaal WMA</p> <p>The options that will be considered within the WMA are :-</p> <ul style="list-style-type: none"> • The implementation of Water Conservation and Water Demand Management (WC&WDM). The water requirements that are used in the development of the WMA water balance do not include WC&WDM. A study quantifying the reduction in the water requirements, return flow volumes and the changes in return flow water quality of implementing

Situation Assessment: (Continued)	<p>WC&WDM has been identified and prioritised in the Vaal OverarchingISP. However Regional Office/CMA must play an active role together with the Water Service providers such as Rand Water in the WMA to ensure the implementation of WC&WDM.</p> <ul style="list-style-type: none"> • Trading of water allocations between users. The Department’s trading policies must be applied when considering trading. • Further development of the local water resource in particular groundwater to meet local water requirements. In this process the impact on the yield of system must be determined and the reduction in yield must be covered at full cost as this will have to be replaced with transferred water. (See Supply to District and Local Municipality Strategy A1.5) • Compulsory licencing can also be used to achieve a water reconciliation in a WMA. At this stage, with the conditional surplus there is no immediate need to implement compulsory licencing in the WMA.
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MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	<p>The management actions associated with the water balance of the Vaal River System are discussed in the Vaal Overarching ISP</p> <p>The management actions that the WMA water managers have to take with regard to the approach to water reconciliation for the local and district municipalities are presented in the Local and District Municipality Strategy A1.5</p>	
Interfaces:	<p>References:</p> <ol style="list-style-type: none"> 1. DWAF Report no: PC 000/00/18496, “Vaal River System Analysis Update: Integrated Vaal River System Analysis” 2. 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. 	

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A.1.4 COMPULSORY LICENSING

Management objective:	Ensure equitable sharing of the available water resources for the Reserve (as the priority user) and activities to maintain the economic and social structures that rely on the water resources of the Upper Vaal WMA.
Situation Assessment:	<p>Vaal River System Perspective</p> <p>As discussed in the Vaal Overarching ISP, there is no immediate need from a water balance, Reserve or water for equity point of view to undertake a compulsory licencing process for the Vaal River System. The economic activities supported by the water resources in the Vaal River System are recognised as the economic engine of south Africa. 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, opportunities are created in the form of revenue for the government that can be allocated to redress inequities.</p> <p>Upper Vaal WMA Perspective</p> <p>As far as the Upper Vaal WMA is concerned there are no known pressures to redress inequities from a water perspective. Land is in the hands of the historically disadvantaged in the Qwa Qwa area of the WMA from a water perspective. This area is generally not good for irrigation due to climate and soils. However with the movement of people from these rural areas to the urban centres, water could become available for emerging farmers. The possibilities in this area need to be investigated.</p> <p>In general, if inequities are to be addressed through irrigation, land will have to be gained through the redistribution of existing land under irrigation. The economics of irrigation dictate that the land will have to be close to water.</p> <p>Although the above status indicates that Compulsory Licensing is not a priority in the whole WMA, there are some specific issues in the key areas of the WMA, which may require compulsory licensing. The issues identified during the workshops were :-</p> <ul style="list-style-type: none"> • The abstraction of irrigation water from the groundwater in the Heidelberg area is drying up local plot owners water • The groundwater situation in the Mooi/Wonderfontein spruit area needs to be investigated. The groundwater in the dolomites in this area is being dewatered by the mines and is used for irrigation and domestic use. There are pressures to expand irrigation and there is uncertainty about the time schedule for dewatering and the ultimate rewatering of the compartments. <p>The approach to be adopted for the above issues is to explore the use of regulations and other measures to address the problems before a compulsory licencing program is pursued.</p>

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	M1. The use of regulations and other measures to solve the problems listed above should be investigated and implemented.	Regional Office (Priority 1)
	M2. Although compulsory licencing will be implemented eventually, other measures should be explored in the short term to address the water availability issues.	Regional Office (Priority 1)

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A.1.5 SUPPLY TO DISTRICT AND LOCAL MUNICIPALITIES

Management objective:	Ensure that local and other authorities have sufficient water resources to supply their requirements and implement measures for efficient utilisation of the available resources. The objective with water supply to local authorities should be to implement economically feasible supply options with acceptable environmental impacts.																		
Situation Assessment:	<p>The following is the general situation as regards water supply to the district and local authorities in the WMA :-</p> <ul style="list-style-type: none"> • A large number of the towns in the WMA are supplied by Rand Water or have allocations from nearby inter basin transfer schemes. • In other cases, towns are located close to a major tributary or have access to water from an upstream storage dam. • The water requirements in the above two situations are considered as part of the water balance of the Integrated Vaal River system as dealt with in the Vaal Overarching ISP. There is a third supply situation as discussed under the Water Balance Reconciliation Strategy, where the town relies partially or fully on local water resources. The local authorities in the WMA, their sources of water and if there are any known water supply problems are listed in the Table below. <p>The approach to be adopted with the towns reliant on the local water resource is that the Department/CMA will give guidance on the approach to follow and the possible supply options that should be investigated. Rand Water should also be consulted as a possible source of supply from their water supply infrastructure. The towns will then apply for a licence through the normal channels.</p> <p>Another important role that the Department/CMA must pursue is the implementation of effective WC&WDM measures in the WMA. This must be pursued both with the local authorities (including local authorities supplied by Rand Water) and Rand Water.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="text-align: center;">Local Authority</th> <th style="text-align: center;">Source of Water</th> <th style="text-align: center;">Comment</th> </tr> </thead> <tbody> <tr> <td>Bethal</td> <td>Rand Water</td> <td>No shortfalls reported</td> </tr> <tr> <td>EMzinoni</td> <td>Rand Water</td> <td>No shortfalls reported</td> </tr> <tr> <td>Ermelo</td> <td>Local sources and Usutu-Vaal Scheme</td> <td>Currently experiencing shortages.</td> </tr> <tr> <td>Amersfoort</td> <td>Local sources and Zaaihoek-Majuba pipeline</td> <td>No shortfalls reported</td> </tr> <tr> <td>Perdekop</td> <td>Local sources</td> <td>No shortfalls reported</td> </tr> </tbody> </table>	Local Authority	Source of Water	Comment	Bethal	Rand Water	No shortfalls reported	EMzinoni	Rand Water	No shortfalls reported	Ermelo	Local sources and Usutu-Vaal Scheme	Currently experiencing shortages.	Amersfoort	Local sources and Zaaihoek-Majuba pipeline	No shortfalls reported	Perdekop	Local sources	No shortfalls reported
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Situation Assessment: (Continued)	Local Authority	Source of Water	Comment
	Morgenson	Local sources	No shortfalls reported
	Memel	Local sources	No shortfalls reported
	Glen Allen	Local sources	No shortfalls reported
	Vrede	Local sources	No shortfalls reported
	Harrismith	Wilge River with support from Sterkfontein Dam	No shortfalls reported
	Frankfort	Wilge River with support from Sterkfontein Dam	No shortfalls reported
	Bethlehem	Local sources with support from LHWP via Liebenbergsvlei River	No shortfalls reported
	Tweeling	Local sources with support from LHWP via Liebenbergsvlei River	No shortfalls reported
	Phuthaditjhaba	Local sources – Fika Patso and Metsi Matso	No shortfalls reported
	Warden	Local sources	No shortfalls reported
	Reitz	Local sources	No shortfalls reported
	Kestel	Local sources	No shortfalls reported
	Standerton	Grootdraai Dam	No shortfalls reported
	Villiers	Local resources from Vaal River in the upper reaches of Vaal Dam	Currently reporting shortages
	Grootvlei	From Vaal Dam via the Grootvlei Power Station infrastructure	No shortfalls reported
	Deneysville	Direct from Vaal Dam	No shortfalls reported
	Secunda	Rand Water	No shortfalls reported
	Greylingstad	Supplied from Balfour	No shortfalls reported
	East Rand Towns	Rand Water	No shortfalls reported
Balfour	Local sources (Haarhof Dam) with emergency supply from Grootvlei Power Station	No shortfalls reported	
Johannesburg	Rand Water	No shortfalls reported	

Situation Assessment: (Continued)	<table border="1"> <thead> <tr> <th>Local Authority</th> <th>Source of Water</th> <th>Comment</th> </tr> </thead> <tbody> <tr> <td>Potchefstroom</td> <td>Local sources - Boskop Dam</td> <td>Problems if mines stop dewatering</td> </tr> <tr> <td>Fochville</td> <td>Rand Water</td> <td>No shortfalls reported</td> </tr> <tr> <td>Parys</td> <td>Abstraction from Vaal River</td> <td>No shortfalls reported</td> </tr> <tr> <td>Vredefort</td> <td>Abstraction from Vaal River and boreholes</td> <td>No shortfalls reported</td> </tr> </tbody> </table>			Local Authority	Source of Water	Comment	Potchefstroom	Local sources - Boskop Dam	Problems if mines stop dewatering	Fochville	Rand Water	No shortfalls reported	Parys	Abstraction from Vaal River	No shortfalls reported	Vredefort	Abstraction from Vaal River and boreholes	No shortfalls reported
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MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	<p>M1. Communicate the approach adopted by DWAF to the development of local resources for water supply. DWAF will specifically approach those local authorities which are currently experiencing shortfalls. The importance and savings that can be made by WC&DM should also be communicated. Special consideration will have to be given to the small towns along the main stem which will not easily implement WC&DM due to the easy access to water to augment their water supply.</p>	Regional Office (Priority 1)
	<p>M2. Provide water resource availability assessments for areas where future developments of the water resources are required. The need for this information should be identified in the WSDP development process and through licence applications (See also M1 Resource Availability Strategy A1.1).</p>	Regional Office (Priority 1)

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A.2 WATER RESOURCES PROTECTION STRATEGY

A.2.1 RESERVE AND RESOURCE QUALITY OBJECTIVES

<p>Management objective:</p>	<p>The rivers in the Upper Vaal WMA 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.</p>
<p>Situation Assessment:</p>	<p>The ecological Reserve using the comprehensive methodology has not been determined for the Vaal River Catchment. Due to the cascading nature of the WMAs in the Vaal River Catchment, the ecological Reserve would best be determined for the Vaal River Catchment as a whole rather than for the WMAs individually. A strategy was developed in the Vaal Overarching ISP and is repeated here.</p> <p>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.</p> <p>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).</p> <p>A Comprehensive Reserve has not been determined for the Vaal River Catchment. 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 defined in the abovementioned study.</p> <p>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.</p> <p>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.</p>

	<p>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.</p>
<p>Interfaces</p>	<p>References</p> <ol style="list-style-type: none"> 1. DWAF report no: PC000/00/18596, "Vaal River System Analysis Update: Environmental considerations in the Vaal River System Analysis Study", 1999. 2. DWAF report no: PRSA C 000/009/0103, "Internal Strategic Perspective : Vaal River System : Overarching, 2004.

<p style="text-align: center;">MANAGEMENT ACTIONS</p>		
<p>Required actions, responsibilities and priorities:</p>	<p>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.</p>	<p>Dir: RDM (Priority 1)</p>
	<p>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.</p>	<p>Dir: NWRP (Priority 1)</p>

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A.2.2 WATER QUALITY MANAGEMENT STRATEGY

Management objective:	<p>The main objective is to ensure a sound and reasonable balance between development impacts and the protection of the resource. Fitness for use by all users (especially downstream users) and protection of the natural ecosystems must be used as the basis for strategy development.</p>
Situation Assessment:	<p>Overview</p> <p>The water quality in the Upper Vaal WMA varies from poor in the highly developed catchments in the WMA to good in the less developed areas. The land use in this WMA 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 around the urban centres. The urban developments consist of 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 WMA.</p> <p>The water quality in many of the catchments are determined by the point source discharges from wastewater treatment plants, industrial effluent discharges and mine dewatering. The water resources of the WMA are supported by transfers of good quality water from adjacent WMAs. These transfers are generally released into the rivers in the WMA and will also impact positively on the water quality of the WMA. The clean water transferred into the catchment has been reported to lead to algal blooms in Vaal Dam due to increased light penetration. This causes problems with the Rand Water water treatment plants.</p> <p>The Amanzi project made proposals on how to manage the decant water volumes from the mining complexes on the East and West Rand. The Department did not accept the proposed funding mechanisms. However the problem of managing the decant water and rewatering of the compartments still remains.</p> <p>There are a number of coal fired power stations in the Olifants River catchment to the north of the Upper Vaal WMA as well as in the WMA. The power stations as well as industries, coal burning for heating and cooking and veld fires, all contribute to the mass of pollutants emitted to the atmosphere. The deposition of pollutants from the atmosphere can contribute to the deterioration of the water quality in the Upper Vaal WMA.</p>

<p>Situation Assessment: (Continued)</p>	<p>The approach to the management of water quality in the Upper Vaal WMA is to develop Water Quality Management Plans or catchment management strategies for sub-catchments in a phased approach by carrying out situation assessments as a first phase followed in subsequent phases by the development of the management plan. During this process water quality objectives (WQO) are set for the sub-catchments in the WMA.</p> <p>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. The ideal WQO are used in licences and a phased approach is adopted to meet the ideal WQO over time. The process of managing the water quality in the WMA is an iterative process of evaluation of management actions including source controls and the revision of the WQO.</p> <p>The WQO that have been developed for the sub catchments may not necessarily meet the needs of the water users in the downstream catchments. The need for an integrated water quality management plan for the Vaal River system has been identified and is discussed in the Vaal Overarching ISP. After the integrated plan has been developed, the WQO and management plans developed for the sub catchments may have to be refined.</p> <p>Water Quality Situation in sub-catchments</p> <p>Summarised descriptions of the water quality situation in the tributaries of the Vaal River are given below. A map showing the sub-catchments is given in Appendix B.</p> <p>Wilge River sub-catchment</p> <p>The Wilge sub area is largely pristine. There are local water quality problems related to wastewater treatment works, poorly managed sewerage reticulation systems and rapid development of some urban areas. Storm water and industrial water management problems in the Phuthaditjhaba industrial complex have also been reported. There is also extensive soil erosion in the Phuthaditjhaba area.</p> <p>The Nuwejaarspruit and the Ash river are used to transport transferred water from the Sterkfontein Dam and LHWP respectively to the Vaal Dam. This has led to erosion problems on the river channels. Remediation measures have been undertaken on the Ash River and a study of the impacts of releases from Sterkfontein Dam on the Nuwejaarspruit is underway. This tributary has a low priority in terms of undertaking a situation assessment and developing a catchment management strategy.</p> <p>Klip (Free State) River sub-catchment</p> <p>The Klip River is largely pristine. The water quality is generally good but a recent assessment of the water quality in the sub-catchments showed an increasing trend in the measured TDS concentrations possibly due to atmospheric deposition.</p>
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<p>Situation Assessment: (Continued)</p>	<p>Grootdraai Dam sub-catchment</p> <p>The water quality in the Grootdraai Dam sub-catchment is dominated by the impacts of coal mining activities. There are a number of abandoned and operational mines in the Ermelo area of the sub-catchment and mines in the Leeuspruit catchment. The Usutu Colliery will be starting up again for export and to supply the Camden power station, which is to be refurbished. The EMPR process is underway for the development of these reserves. There are further coal reserves, which could be developed in the sub-catchment.</p> <p>The water quality of Grootdraai Dam is under threat from the coal mining activities. The further deterioration of the water quality in the dam will have significant cost and water requirement implications for Sasol Secunda and the power stations supplied from the dam.</p> <p>The Department of Water Affairs and Forestry have started with the rehabilitation program of discard dumps and some of the workings. The mines in the sub-catchment are managed by means of the EMPR process and there have been improvements in the rehabilitation efforts of the mines in the catchment. The volumes and quality of the decant water from the mines after closure needs to be determined and the future management of the water determined.</p> <p>There are some local eutrophication problems associated with the management and non compliance of wastewater treatment plants and land fill sites in the sub-catchment. Agriculture is also thought to contribute to the nutrient and sediment loads in the river system.</p> <p>A situation assessment as phase 1 of the development of a CMS has been completed and a CMS will be developed in the near future.</p> <p>Grootdraai to Vaal Dam sub-catchment</p> <p>The water quality problems in this catchment include salinity, nutrients and microbiological pollution. The salinity in this sub-catchment is dominated by the Sasol coal mining and synthetic fuel industry as well as the gold mines in the Waterval catchment. The sources of salinity are both diffuse and point sources. The diffuse sources are related to ash dams and surface runoff from mining and industrial complexes. The nutrient problems are related to the wastewater treatment plant discharges, poorly managed sewerage systems, irrigation return flows and stormwater runoff from urban areas in particular dense settlements.</p> <p>The situation assessment of the Waterval sub-catchment has been completed as Phase 1 of the development of a CMS for the area. Phase 2 of the development of a CMS for the Waterval catchment has been started. Phase 2 will develop water quality management plan for the catchment. There has been a study program undertaken by Sasol mining to address the water balance and quality of the excess mine water that can be expected during mining and after closure. The results of this work will be captured in the CMS.</p>
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<p>Situation Assessment: (Continued)</p>	<p>Suikerbosrand / Blesbokspruit sub-catchment</p> <p>The water quality problems in this sub-catchment include salinity, eutrophication, public health and organic load. The salinity problems are largely related to the mining industry with the Grootvlei dewatering, seeps from tailings dams and industrial discharges such as from SAPPI. The wastewater treatment plants in the sub-catchment can also contribute to the salinity levels if they receive industrial effluents. A licence currently governs the Grootvlei discharge. The licence conditions need to be implemented. These include the construction of a desalination plant to treat the water. There are a number of wastewater treatment plants which discharge into the Blesbokspruit/Suikerbosrand sub-catchment.</p> <p>These discharges add nutrient loads and organic load to the river system. There are often local public health issues linked to the discharges. The stormwater runoff from the dense settlement areas also add nutrients and sediment to the river system. There is a lack of flow measurements in this sub-catchment particularly in the Blesbokspruit. A period of monitoring is required before a CMS can be developed.</p> <p>There is water flowing across a number of outcrops in the river beds. These outcrops are often holed and allow water into the mine workings. The water is then pumped from the workings as part of the dewatering process. The inflow of additional water increases the pumping costs and the water quality of the water entering the mine deteriorates before it is returned to the river system.</p> <p>The river systems flow patterns and water quality is dominated by the point discharges. The additional water and nutrients have led to the development of extensive wetlands. These have reduced the capacity of the river system to convey water and increased the level of sedimentation.</p> <p>The excess water that continuously flow in the Blesbokspruit was cited as an issue by the catchment Forum. At this stage a CMS has not been developed for this area although a management plan has been developed for the RAMSAR wetland.</p> <p>Klip (Gauteng) sub-catchment</p> <p>The water quality situation in the Klip River is similar to the Suikerbos/Blesbokspruit. The water quality and flow patterns are impacted by point sources, mining (in particular the tailings dams) and urbanisation. The problems are salinity, eutrophication, public health and radioactivity. The approach to be used to managing the radioactivity problem should be developed with the relevant regulators. Flow measurements are needed in the catchment. The situation assessment for the catchment has been completed and a CMS needs to be developed for the sub-catchment.</p>
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<p>Situation Assessment: (Continued)</p>	<p>Vaal Dam to Barrage Key Area</p> <p>The water quality issues in the Vaal Barrage include eutrophication with outbreaks of blue green algae and some hyacinth reported as well as increased salinity. The level of algae in the Barrage are aggravated by the low turbidity water released from the Vaal Dam which increases the light penetration depth. The treatment processes at the Rand Water water treatment plants are not designed to handle excessive algae. The Barrage is well used for recreational purposes and for river front developments. The public health of this stretch of water is therefore also a concern.</p> <p>The water quality in the Vaal Barrage is determined by the water quality from upstream as well as activities within the sub-catchment. The Barrage is receiving inputs from the Suikerbosrand/Blesbokspruit, the Klip (Gauteng) and the sub-catchments upstream of Vaal Dam. The activities within the sub-catchment which effect water quality, are those in the Rietspruit and Taaiboschspruit catchments. The activities in the Rietspruit include the Iscor complex, irrigation activities, wastewater treatment plant discharges, gold mining and urban developments. The activities at Iscor are also impacting on the groundwater quality. The situation assessment for the Rietspruit catchment has been completed.</p> <p>The phase two needs to be initiated to develop a CMS which will address the main issues in the catchment related to mine discharges, irrigation and Iscor.</p> <p>The water quality of the Taaiboschspruit is largely determined by the water management practised on the petrochemical complexes around Sasolburg. There are expansions proposed to the petrochemical plants in the area. There are problems with the use of the Driefontein Dam for the disposal of effluent by a number of the industries in the Taaiboschspruit. The dam is spilling to the surface water and seeping to the groundwater. The Department of Water Affairs and Forestry has entered a process with the industries concerned. A phase 1 situation assessment study will be initiated as the start of the development of a CMS.</p> <p>There are also operational coal mines active on the banks of the Vaal River. These require careful management as they can have an impact on the water quality of the Vaal particularly after closure. There are further reserves that will be developed in this area.</p> <p>The salinity in the Vaal Barrage is managed by dilution with water from Vaal Dam to maintain a concentration of 600 mg/L in the Barrage.</p> <p>Mooi sub-catchment</p> <p>The water quality problems experienced in this sub-catchment are radioactivity from the tailings dams and tailings that have washed into the streams over time. The eutrophication and public health problems experienced are due to stormwater runoff from urban areas and discharges from the wastewater treatment plants. There are also management issues around the landfill sites. The salinity problems are associated with the mining activities in particular mine dewatering discharges as well as seepage from tailings dams. There are also toxicity issues around the seepage from the tailings dams and slag dumps in terms of acid mine drainage and their associated heavy metals.</p>
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Situation Assessment: (Continued)	<p>There are large dolomitic compartments in the Wonderfonteinspruit catchment. The Far West Rand Dolomitic Association has been established to manage the dolomites. There is a history of sinkholes in the area. The repair of the sinkholes with waste rock and cement stabilised tailings is being considered. The use of these materials for filling sinkholes is the subject of a Water Research Commission project.</p> <p>There are also concerns about the refilling of the dolomitic compartments after the closure of the mines. The concerns are the water quality that can be expected at the decant points, the volumes of decant and the positions of the decants.</p> <p>A situation assessment has been carried out in the sub-catchment. The situation assessment identified the need for monitoring to better understand the water balance and contribution of load from the different pollution sources. A CMS needs to be developed which specifically addresses the rewatering of the dolomitic compartments.</p> <p>Barrage to Mooi sub-catchment</p> <p>There are no significant tributaries in this sub-catchment. However the water quality in the reach of the Vaal River that flows through the sub-catchment reflects the water quality of the water received from upstream. The water quality being affected by operations of the upstream dams and land use activities in the upstream sub-catchments. The water quality problems typically experienced are eutrophication with algae and hyacinth present in the water due to elevated nutrient loads from upstream as well as raised salinity levels. The salinity levels are managed by dilution of water from Vaal Dam to support downstream users (to maintain the Vaal Barrage TDS Concentration at 600 mg/l).</p>
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MANAGEMENT ACTIONS			
Required actions, responsibilities and priorities:	M1.	Quantify the contribution of atmospheric deposition to water quality	Overarching ISP
	M2.	Develop an integrated water quality management plan for the Vaal and Orange River systems to assess pollution source management. (This was identified, described and priorities assigned during the Vaal and Orange Over Arching Workshops).	Overarching ISP
	M3.	The regional office must continue with the process of developing CMS for the sub-catchments on a priority basis.	Regional Office (Priority 1)
	M4.	There has been communication with the relevant regulators and a water quality guideline for radioactivity is being drawn up by the IWQS. For the sub-catchments where radioactivity is an issue (Klip and Mooi sub-catchments), the guideline needs to be applied to determine the extent of the problem.	Regional Office (Priority 1)

Required actions, responsibilities and priorities: (Continued)	M5. An Interdepartmental Committee has been established to manage the situation regarding the holings and the pumping from underground. The extent of the problem needs to be assessed by the Department through the interdepartmental committee. The existing program of sealing the holes should continue and the problem assessment should be used to prioritise the hole sealing program.	Regional Office Ongoing
	M6. In the Leeu/Taaiboschspruit, the findings of the management plan that is currently being developed need to be implemented for the Driefontein Dam.	Regional Office (Priority 1)
	M7. The situation as regards the state of the flow measurement in the Klip (Gauteng) and the Rietspruit sub-catchments need to be determined and the appropriate actions taken	Regional Office (Priority 1)
	M8. Working for water should be approached for cleaning strategies for the hyacinth and algae problem on the Barrage.	Regional Office (Priority 1)
	M9. The management strategies for mine decants and rewatering needs to be developed as part of the Integrated Water Quality Study of the Vaal River Catchment.	Dir .NWRP (Priority 1)
	M10. The management of stormwater runoff from urban areas, sewage treatment plant discharge and irrigation return flows are common to all the WMA in the Vaal River catchment. A strategy has been developed under the Vaal Over Arching ISP.	
	M11. The latest research on sinkhole repairs needs to be reviewed and the Department's policy defined.	Regional Office (Priority 1)

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A.3 WATER USE MANAGEMENT STRATEGY

A.3.1 GENERAL AUTHORISATION STRATEGY

Management objective:	To make use of General Authorisations with a view to cutting down on unnecessary administrative efforts of water use activities that can be allowed without individual water use licences.
Situation Assessment:	<p>The NWA makes provision for certain basic water uses (ie small in volume and which have a minimal impact on quality) to be conducted without formal authorisation using general authorisations. The general authorisations have been revisited and a document prepared in terms of section 39 of the NWA (1998). The decisions have been circulated for comments. The onus lies with the Regional Office to review the general authorisations and ensure that the needs of the Upper Vaal WMA are adequately covered.</p> <p>Specific amendments that were raised at the workshops are listed below.</p> <ul style="list-style-type: none"> • The allowable capacity for storage should be reduced from 50 000 m³ to 10 000 m³ per property. • No taking of water should be allowed. • Feed lots should be added. Guidelines for the feed lot GA need to be addressed at the National Level.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	M1. Refine the conditions specified for General Authorisations to incorporate the above mentioned amendments.	Water Use and Regional Office (Priority 1)

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A.3.2 LICENSING STRATEGY

Management objective:	Licensing of water use (as defined in the National Water Act) should be considered on a continuous basis when applications are received. The licences should be considered in accordance with the framework as presented below
Situation Assessment:	<p>Considerations for water abstraction licences:</p> <p>Due to the “conditional” excess water available in the Vaal River System (see Strategy 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.</p> <p>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.</p> <p><i>Directives and guidelines to apply when evaluating new licences to be allocated from the conditional surplus:</i></p> <ol style="list-style-type: none"> 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 Strategy 1.3, the Eastern Sub- system of the Vaal River System will require augmentation. 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 refers 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 ect. <ol style="list-style-type: none"> 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.

<p>Situation Assessment: (Continued)</p>	<p>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 license will be required. However, if the recipient is located on a river where other parties could be affected, a license is required.</p> <p><i>Other general conditions are:</i></p> <ol style="list-style-type: none"> 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 can be issued if it is found that the conditions pertaining to the specific water resource can support the demand. <p>Status with respect to Discharge Licenses:</p> <p>Applications for discharge licences will be addressed through the licencing procedures. The forms will be accompanied by the required support documentation, which includes an impact assessment. Where a CMS is available, the WQO and any other conditions contained in the CMS will be used to evaluate the application. Where a CMS is not available, WQO will be set based on a water user survey and an ecological assessment of the receiving water body.</p> <p>Upon completion of the planned Integrated Water Quality Management plan for the Vaal River Catchment, the CMS and WQO developed for the sub-catchments may have to be refined based on the integrated plan. This could mean that the discharge licences issued need to be reviewed.</p> <p>Grootdraai – Vaal Dam (Waterval)</p> <p>This catchment faces water quality problems as a result of discharges from the mines and Sasol Synthetic Fuels. However a CMS is being developed which will address discharge licencing issues in this catchment. Sasol has also undertaken extensive work to address their current and future discharges. The CMS will include Sasol's planning in the development of the CMS.</p> <p>Suikerbosrand (Blesbokspruit)</p> <p>A licensing issue involving the Grootvlei Mine is under discussion. Legal questions have been raised surrounding the issue of Grootvlei Mine re-selling desalinated water to Rand Water.</p> <p>Vaal Dam – Vaal Barrage</p> <p>Licensing of effluent is more important than abstraction due to the pollution problems from the mines, Sasol and Iscor. Rand Water abstracts water from the Barrage for its treatment plant.</p>
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Situation Assessment: (Continued)	<p>Klip (Gauteng) There are water quality and flow problems in the sub-catchment. Due to the point discharges, the base flows in the river are higher than natural conditions. This exacerbates flooding in the river and this will have to be considered when issuing licences.</p> <p>Mooi River Licensing of discharges is very important, particularly in respect of mine discharges. The discharges play an important role in the water quality experienced in the catchment and are an important source of water for downstream users.</p>
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MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	M1. Apply licencing procedures outlined in the situation assessment	Regional Office (Priority 1)

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A.4 WATER CONSERVATION & WATER DEMAND MANAGEMENT

<p>Management objective:</p>	<p>To make more effective and efficient use of the existing available water resources in all water user sectors. This will enable the Catchment Management Agency (and indeed DWAF) to conserve this scarce resource and avoid expensive schemes for transfers and storage when these may not be necessary if demand is properly managed.</p>
<p>Situation Assessment:</p>	<p>General</p> <p>There is a need for the efficient use of water at all times even though there is sufficient water to meet the projected water requirements until 2025. Water Conservation and Demand Management (WC&DM) should therefore be encouraged by the Department in all sectors as WC&DM</p> <ul style="list-style-type: none"> • Postpones capital expenditure (to extend bulk distribution systems) for the development of a new water sources • Reduces water supply operating costs • Potentially reduces costs of wastewater treatment due to lower volumes of return flow. <p>The water managers in the Upper Vaal WMA must make assessments of what can be achieved with the implementation of WC&DM in their area. Targets will be established and the costs of achieving the targets determined. This will result in achievable water savings from WC&DM. The WC&DM savings determined in each of the WMAs in the Vaal River system will be used in the Reconciliation Strategy of the Vaal Overarching ISP to set a schedule of goals for WC&DM for the system. This will be in the form of volumes to be saved and when these savings should be achieved. It will than be up to each WMA to achieve the goals set by the Overarching Strategy.</p> <p>There are currently several initiatives by Local Authorities and service providers to implement WC&DM measures and it is perceived that large savings could be achieved in the gross demand of the urban sector. Similar initiatives should be encouraged by the Department in the agricultural sector. The water requirements in the agricultural sector are not projected to grow. Any savings in water in the sector achieved through WC&DM could be traded to meet the growth in the water requirements of other sectors.</p> <p>In implementing WC&DM, however, cognisance should be taken of the fact that a large portion of the water abstracted is returned to the system as a return flow and becomes a resource for downstream use. This has the implication that the measures which reduce return flows do not necessarily increase the overall availability of the water resource.</p>

Situation Assessment: (Continued)	<p>A further factor to be considered when implementing WC&DM measures is to achieve a balance between savings in costs and maintaining an income stream that covers the cost of existing infrastructure without exorbitant increases in the water tariffs.</p> <p>It is important that WC&DM initiatives strike an optimal balance between unrestricted escalating growth at the one extreme, and undue restrictive regulation and interference with market forces, on the other hand.</p> <p>Scope for savings: It is estimated that 27% of water sold by Rand Water is lost through reticulation and domestic leaks, and a further 25% of the water is used inefficiently. (Chapter 5 of the Upper Vaal WMA WRSAS Report).</p>
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MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	M1. In the Over Arching ISP the need was identified for a study to determine how the projected water requirements and return flows would be affected by WC&DM measures. A database and computer model to enable the impact of WC&DM on water requirement projections and return flows needs to be developed for the WMA.	Dir NWRP (Priority 1)
	M2. The Forums and licensing processes should be used to ensure the application of WC&DM.	Regional Office (Priority 1)
	M3. DWAF and Rand Water must liase on WC&DM. The legal and institutional structures and responsibilities of the relationship between DWAF, Rand Water and the local authorities regarding WC&DM needs to be determined.	Regional Office (Priority 1)

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A.5 INSTITUTIONAL DEVELOPMENT AND CO-OPERATIVE GOVERNANCE SUPPORT MAIN STRATEGY

A.5.1 INSTITUTIONAL DEVELOPMENT

Management objective:	<p>The Regional Office (as the interim CMA) need to maintain and develop institutional structures to facilitate the management of Water Resources. The Regional Office will be supported by DWAF Head Office Directorates. Their main objective is to responsibly manage the water resources of the Upper Vaal WMA in the interim until such time as the Catchment Management Agency can take over some of the functions.</p>
Situation Assessment:	<p>General</p> <p>There are 13 catchment management forums in the Upper Vaal catchment, each representing a particular sub-catchment. They are made up of interested and concerned citizens, as well as the major water users, and are very active in the practical review and implementation of the various water resource management issues in the catchments. The major water users and service providers in the WMA are Eskom, SASOL and Rand Water as well as irrigation. The NGOs and CBOs need to be encouraged and assisted where possible to participate in the forums to address the problem with representation at these forums which threatens their legitimacy. The existing forum structure must be expanded where necessary and representation improved.</p> <p>The forum structure should also be used as the basis for the establishment of the CMA. This process must be initiated and follow the framework for CMA establishment to put the CMA board in place by 2005.</p> <p>Institutions at District and Local Municipal level are relatively new on the scene and water resource and water service capacity is slowly being built in these institutions. Liaison between the various institutions needs to be encouraged in the interest of integrated water resources management in the Upper Vaal Catchment. The Department must encourage co-operative governance by interfacing actively with the local authorities and provide input into the WSDP and IDPs.</p> <p>Irrigation boards and government water schemes are currently being transformed to Water User Associations. This process will continue and these institutions will fulfil their roles in line with the NWA , WSA and the NWRS.</p>

MANAGEMENT ACTIONS			
Required actions, responsibilities and priorities:	M1.	Continue assisting the NGOs and CBOs and empowering the Forums. More support (especially basic financial support) needs to be considered to the various forums, since they fulfil a key role in the establishment of these institutions. Promotion of these forums is crucial in order to ensure that the forums are representative of all the roleplayers/ stakeholders in the catchment.	Regional Office (Priority 1)
	M2.	The proposal for establishing the CMA must be prepared for submission to the Minister	Regional Office (Priority 1)
	M3.	The process of transforming irrigation boards to WUA must be continued	Regional Office (Priority 1)
	M4.	The Department must continue to communicate with local authorities and provincial government through the available Forum and provincial liaison structures	Regional Office (Priority 1)

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A.5.2 POVERTY ERADICATION

Management objective:	<p>The main objective is to contribute to the eradication of poverty through :</p> <ul style="list-style-type: none"> • The provision of basic community water supply and creation of employment in developing community water supply and sanitation infrastructure. • Making water available for irrigation by Resource Poor Farmers (RPF) • Ensuring that water is available and does not limit economically productive activities associated with urban centres, major industry and mining.
Situation Assessment:	<p>The Upper Vaal WMA is an economically important area contributing 20% to South Africa's GDP. The continued growth in the economy will generate wealth for the country which will contribute to the eradication of poverty. The provision of water at an adequate assurance of supply and water quality is essential to sustain the projected economic growth. The Department must therefore continue to plan and operate the Vaal River System to meet the water requirements at an adequate assurance of supply and to protect the water quality of the water resources.</p> <p>The water transferred into the WMA is imported at a high cost. As set out in the licencing strategy, new water use will be supplied at full cost. Poverty eradication schemes are unlikely to be sustainable if the full cost is applied. Opportunities will therefore have to be found where the existing water allocations are made available for poverty eradication schemes. Similarly water saved through WC&DM, particularly in the agricultural sector can be used. The Department must identify opportunities and facilitate the transfer of water allocations from the commercial irrigation sector to RPF.</p>

MANAGEMENT ACTIONS		
	M1. Opportunities for poverty eradication by means of irrigation schemes should be identified by the Department and the process of transfer of water allocations facilitated by the Department	Regional Office (Priority 1)
	M2. Contact other Departments such as the Department of Land Affairs to identify opportunities for poverty eradication projects	Regional Office (Priority 1)

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A.6 INFRASTRUCTURE DEVELOPMENT & SUPPORT STRATEGY

A.6.1 WATER INFRASTRUCTURE DEVELOPMENT & MANAGEMENT MAIN STRATEGY

<p>Management objective:</p>	<p>Provision of adequate water resource development infrastructure (storage) and bulk water supply infrastructure to sustain and encourage social and economic growth.</p>
<p>Situation Assessment:</p>	<p>The Upper Vaal WMA is part of the Vaal River Catchment. This system is supported by water supply infrastructure located in surrounding WMAs and countries. The future growth in the water requirements of the Upper Vaal WMA will be met by transfers. The planning of the future infrastructure development and implementation is discussed in detail in the Vaal and Orange Overarching ISPs. For details these reports should be consulted.</p> <p>As discussed in the Water Reconciliation Strategy A1.3, the future infrastructure that has been agreed to in principle is the construction of a pipeline from Vaal Dam to Trichardtsfontein Dam to provide support for the water users supplied from Grootdraai Dam. The process that will be followed in the planning of the pipeline is a bridging study to confirm demands, route and pipeline size. This will be followed by design and implementation phase. The construction of the pipeline will be fast tracked due to the prevailing drought conditions. If the drought conditions persist, the weir scheme conveying water from Vaal Dam to Grootdraai Dam may be implemented as a temporary measure to alleviate the water availability situation at Grootdraai Dam.</p> <p>The future of the treatment/re-use options as far as the management of sewage treatment plant discharges and regional treatment of mine water decants is uncertain. The future of these schemes will be decided as part of the Integrated Water Quality Study for the Vaal River Catchment.</p> <p>The capacity of the 1,0 m diameter pipeline is now insufficient to convey the runoff water generated in the Upper Wonderfonteinspruit across the dolomitic compartments in the Lower Wonderfonteinspruit. The pipeline system was installed by the mines and is run by the Far West Rand Dolomitic Association (FWRDA). The reasons for the lack of capacity are the increased runoff from upstream due to urbanisation and the increased sewage return flows. This problem will be investigated as part of the rewatering study for the area.</p>

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	M1. The infrastructure planning is described in the Vaal Overarching	
	M2. The 1,0 m pipeline will be addressed as part of the study which investigates the rewatering of the dolomites.	Regional Office (Priority 1)

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	Date:	March 2004
	Author:	ISP Study

A.6.2 SYSTEM MANAGEMENT STRATEGY

Management objective:	Implement system management measures to optimally utilise the available water resources, in terms of short-term benefits and to maintain the reliability of supply over the long-term. The aim is to postpone the need for augmentation as far into the future as possible while saving operating costs over the short-term.
Situation Assessment:	Annual operating analysis is currently undertaken to assess water quality management options for the Vaal Barrage and Rand Water supply, assessment of pumping costs, and level of restrictions if in a drought. The details of the operating analysis are discussed in the Vaal and Orange Overarching ISP reports. These annual operating runs will be done at the national level and not by the Upper Vaal CMA due to the interdependencies between WMAs.

MANAGEMENT ACTIONS	
Required actions, responsibilities and priorities:	See Vaal Overarching

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	Author:	ISP Study

A.6.3 PUBLIC HEALTH & SAFETY STRATEGY

Management objective:	<p>We need to protect the water resource, and ensure that users in the Vaal River Catchment area are safe from the effects of poor water quality that can create health problems (eg cholera), and we need to ensure that strategies are in place to deal with floods as these impact on the socio-economic environment.</p>
Situation Assessment:	<p>The Department's current commitments are associated with:</p> <ul style="list-style-type: none"> • Reducing pollution and preventing serious or hazardous pollution events. • DWAF/CMA will be required to become involved in supporting and enforcing disaster management planning by all relevant authorities. • Flood Management Protocols. The areas along the Barrage particularly at Vereeniging are under threat of flooding. Department has developed a set of flood operating rules and warning systems for the Vaal river system. The flood management system is applied by Head Office in conjunction with the regional office. • Dam safety policy (DWAF). The Grootdraai and Vaal Dams are national key points. Operation manuals and dam safety aspects of the dams need to be reviewed periodically. • Co-operating with the Department of Agriculture on drought relief strategies and policy formulation. • Pollution of water resources (ie limiting health hazards such as cholera). There are dense settlements in the WMA without adequate sanitation. In addition many of the existing sanitation systems are poorly managed and maintained. This can lead to high health risks such as cholera. There have been no significant outbreaks of cholera in the WMA as about 98% of the WMA domestic use is supplied by Rand Water. <p>Klip(Gauteng) and Suikerbosrand Local flooding problems are experienced in the Klip and Blesbokspruit rivers.</p>

MANAGEMENT ACTIONS			
Required actions, responsibilities and priorities:	M1.	The Department must continue to comply with the above-mentioned requirements.	Regional Office (Priority 1)
	M2.	The issues related to flood management are dealt with in the Vaal Overarching ISP.	See Overarching
	M3.	The O&M manuals are in the process of being updated. The contents of the updated manuals must be communicated and implemented.	Regional Office (Priority 1)
	M4.	The areas of public health risk need to be categorised and the extent of the public health risk determined. Monitoring and warning protocols need to be developed and implemented.	Regional Office (Priority 1)

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	Date:	March 2004
	Author:	ISP Study

A.7 MONITORING AND INFORMATION MANAGEMENT STRATEGY

<p>Management objective:</p>	<p>The 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.</p>
<p>Situation Assessment:</p>	<p>The strategy for monitoring must be developed in an integrated manner. The co-ordination will be between government departments and Directorates within the Department. The responsibility however for the development of the monitoring and information management system for Upper Vaal WMA will be the responsibility of the regional office and ultimately the CMA. There will also be a need for co-ordination with the needs of Head Office in terms of monitoring and information requirements.</p> <p>Some specific issues in the Upper Vaal WMA are:</p> <ul style="list-style-type: none"> • There is a lack of reliable information on irrigation return flow and qualities • Reliable flow gauging is needed in the Barrage Catchment. • Database of effluent discharge data. • Flow measuring and water quality monitoring are needed on the Blesbokspruit • Flow measurement on the Suikerbosrand River upstream of its confluence with the Blesbokspruit. • Additional monitoring on the Natalspruit and extension of the DT for the gauge on the Small Rietspruit. • Flow measurements of the mine discharges and in the water conveyance infrastructure are needed in the Mooi key area • Additional rain gauges are needed. • Groundwater monitoring <p>There is a need to develop an integrated monitoring and information management plan. The plan must assess requirements, priorities, costs and provide motivation for funding.</p>

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	<p>M1. An integrated monitoring and information systems plan needs to be developed and implemented. The plan must reconcile the monitoring requirements of all Departments in the WMA with the current monitoring programs. The gaps must be identified and an appropriate monitoring program designed.</p>	Regional Office (Priority 1)

Strategy Version control:	Version number:	1
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	Author:	ISP Study

A.8 IMPLEMENTATION STRATEGY

Management objective:	<p>To ensure that the approaches put forward by the Department through this ISP are adopted and implemented in the WMA. This will require willpower, funding and capacity.</p>
Situation Assessment:	<p>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 Upper Vaal WMA – and lists suggested actions towards achieving good management of the water resource.</p> <p>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 Upper Vaal WMA. 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.</p> <p>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 in a way that has never been done before. 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.</p> <p>The ISP is not yet a document of recognised status.</p> <p>The ISP is subject to the approach set out in the NWRS – and details this approach for the Upper Vaal WMA. 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. Despite this the approaches and requirements of this ISP may not be ignored.</p> <p>The Implementation of the ISP is an enormous task. Never before have all the hopes and expectations of the Department been gathered together into one document. 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.</p>

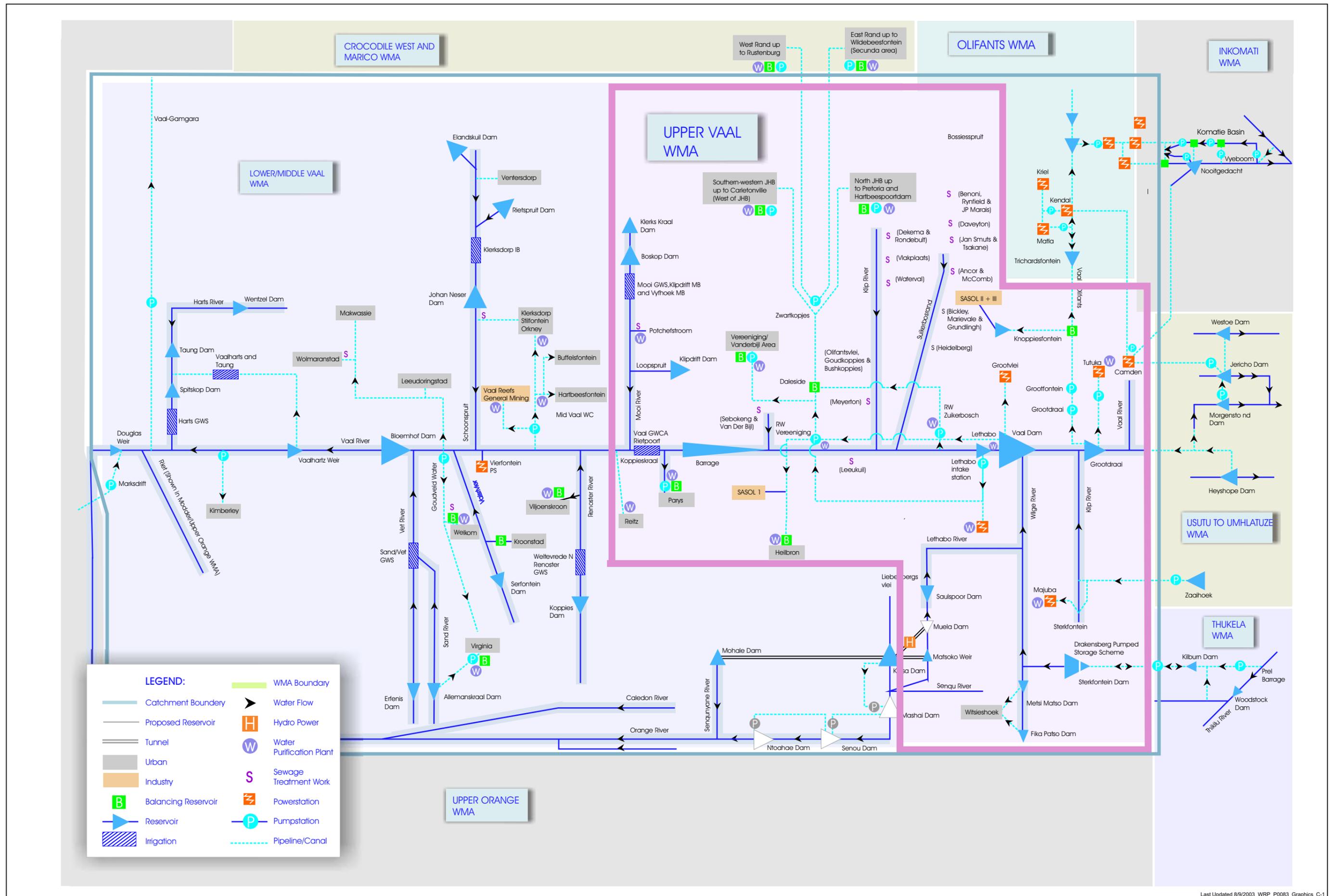
<p>Situation Assessment: (Continued)</p>	<p>It is recognised that it is quite impossible to immediately launch into, and achieve, all that is required by this ISP. Funds and capacity are, and will always be, blocks that must be climbed over. The approach is to take the ISP and to use it as instruction, 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.</p> <p>The NWRS gives us firmer ground now that it is coming on line. The ISP needs to be acknowledged by Legal Services and the Water Tribunal as the next level of accepted planning. For the ISPs to be accepted like this they would need to have stakeholder approval. We need a national strategy aimed at giving the ISP this authority.</p>
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<p style="text-align: center;">MANAGEMENT ACTIONS</p>		
<p>Required actions, responsibilities and priorities:</p>	<p>The following actions are required:</p> <p>M1. 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.</p> <p>M2. 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 WC&DM, are taken out forcefully both to local authorities, other direct water users such as agriculture, and the wider public.</p> <p>M3. Collate comment and consider this in revising and improving the ISP.</p> <p>M4. There is a need to develop materials – suitable for the provincial cabinet, the various management committees, the mayor’s forum. Also to support the Water Services Development Plan, Organised Agriculture, Emerging Farmers, etc. This should be suited to the preparation of the Provincial Growth and Development Strategy, and other regional and provincial planning activities.</p> <p>M5. The ISP should, in any event, be open to continuous improvement, with possible updating on a bi-annual basis.</p> <p>M6. All Regional staff, Working for Water, (Rand Water, Eskom and the mining industry), and other major stakeholders should have access to, or copies of, the ISP</p>	<p>Regional Office (Priority 1)</p>

<p>Required actions, responsibilities and priorities: (Continued)</p>	<p>M7. 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!</p> <p>M8. The practicalities of implementation demands must always be considered.</p> <p>M9. 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.</p>	
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<p>Strategy Version control:</p>	Version number:	1
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Appendix B
Figures



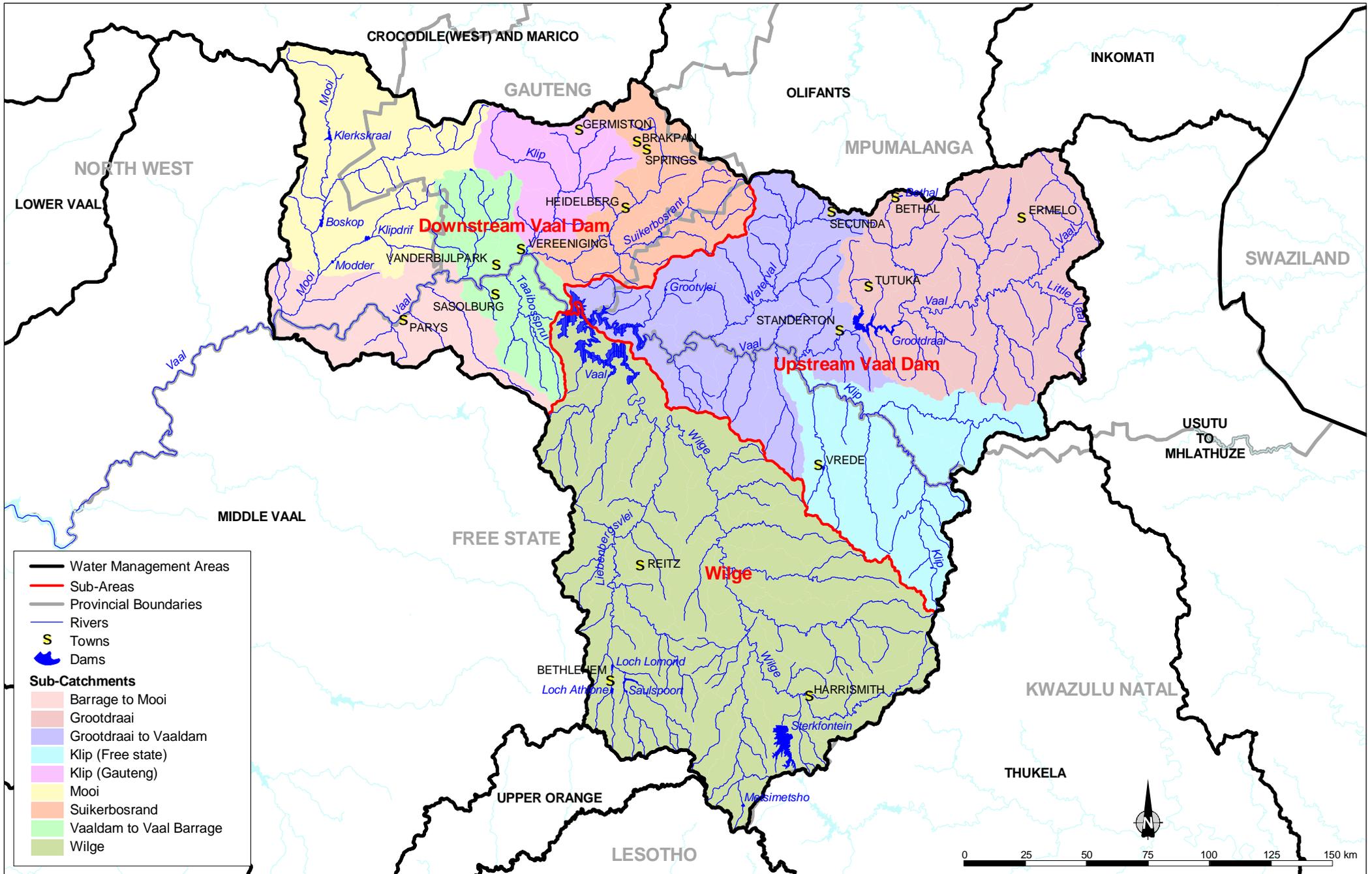
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CENTRAL CLUSTER:
UPPER VAAL WATER MANAGEMENT AREA ISP

Schematic of the Integrated Vaal River System

B-1



- Water Management Areas
- Sub-Areas
- Provincial Boundaries
- Rivers
- Towns
- Dams

Sub-Catchments

- Barrage to Mooi
- Grootdraai
- Grootdraai to Vaaldam
- Klip (Free state)
- Klip (Gauteng)
- Mooi
- Suikerbosrand
- Vaaldam to Vaal Barrage
- Wilge

Appendix C
Groundwater Report

DEVELOPMENT OF INTERNAL STRATEGIC PERSPECTIVES

GROUNDWATER OVERVIEW FOR UPPER VAAL CATCHMENT MANAGEMENT AREA

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October 2003

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1 Overarching Issues

The following is a brief description of the major groundwater issues in the Upper Vaal Water Management Area (WMA).

1.1 Availability of groundwater information in the catchment area

The following data sources with regard to groundwater are available:

- NGDB database
- WARMS database
- Catchment Management Studies/ Reports
- GH Reports, WRC projects and related MSc Thesis's
- Geohydrological maps
- EIRs and EMPRs
- Consultant reports

Although there are many available sources of groundwater data it is often not easy to access the data. The NGDB and WARMS databases are populated with a number of points. However the NGDB often only contains water level measurements. Very little is available on abstraction volumes and water quality of groundwater. The WARMS database contains information regarding abstraction of groundwater for all registered and licensed users. This data still needs to be verified.

Other data sources in the public domain include Catchment Management Studies (e.g. Leeu/Taaibos Spruit Catchments), geohydrological maps (e.g. Vegter and Barnard), GH and WRC reports. Also include in this group is the chapters in EIRs and EMPRs dealing with impacts on the groundwater domain. The data is very valuable since the studies are mainly focused on a regional scale and deals with specific groundwater related problems. It should be noted that this data needs to be centralized in a database such as the NGDB or WMS, in order to make the data more accessible for management purposes on a catchment scale.

Another source of valuable information that is not readily available, is consultant's reports. Often industries and mines request consultants to investigate specific groundwater issues on their properties. These investigations are normally focused on site-specific scale. These reports are mostly discussed with DWAF but the data does not become public domain.

1.2 Overview of groundwater resources and use throughout the catchment area

1.2.1 Industrial and mining

The mining sector has a significant impact on the groundwater regime in the WMA. The mining activities that are mainly responsible for disturbances in the groundwater regime are gold and coal mining. The water pumped for dewatering of the underground workings is the most significant impact of the mines on the water resource balance. The associated salinity loads of these discharges to surface water resources contribute to the high salinity load of the downstream Vaal River system. Mining activities impact on the Klip Spruit, Suikerbosrand, Vaal Dam to Vaal Barrage and Mooi key areas.

Coal mining is associated with the Karoo formations and is concentrated in the upper reaches of the WMA. There are several active as well as defunct coal mines located between Ermelo and Secunda and also in the Vereeniging-Vanderbijlpark-Sasolburg area (Leeu/Taaibos Spruit). Dewatering of coal workings during operation does not have a significant impact on the overall hydrology of the river systems. Groundwater pumped from underground workings is utilized together with other water sources for road wetting and dust suppression, beneficiation plants and at slurry dams. The majority of the water is evaporated with a small percentage released back into the river systems. (Pulles et al., 2001).

Groundwater abstracted from gold mines is utilized in similar ways as the coal mines, namely for processes at plants, tailings deposition and a portion is discharged on surface. Some groundwater is abstracted from boreholes on local scale for domestic and recreational irrigation purposes. No figures are available on the volumes. Dewatering of the dolomitic compartments due to gold mining activities on the West Rand, has lowered the water table and led to the drying up some of the natural "eyes" (Hodgson et al., 2001). This has negatively impacted on other users, e.g. irrigation farmers. Once mining ceases re-watering of the mine openings and dewatered dolomites will take place, but a pre-mine situation will never be achieved. Discharge points will either be at low-lying springs or shaft areas; or due to the destroying of the compartmentalizing effect of all but the Turffontein dyke, the Turffontein "eye" might become a discharge point (Hodgson et al., 2001). Further studies have been recommended to determine the total extent of impact (quality and quantity) of rewatering on the geohydrological and hydrological regimes.

In the Suikerbosrand key area, the Grootvlei Mine pumps/decant polluted groundwater to the Blesbokspruit and its RAMSAR wetland. Negotiations are underway with DWAF to address the problem. Possible solutions include desalination and decreasing the amount pumped. Durban Roodepoort Deep and ERPM gold mines in the Klipspruit key area are currently decanting into the Upper Klip River and Elsburgspruit respectively. Several other gold mines also discharge in the Vaal Dam to Vaal Barrage key area and the far West Rand Basin's gold mines discharge into the Mooi key area.

Major industries in this WMA include Sasol Chemical Industries, DOW Chemicals, Omnia Fertiliser, Iscor, Sappi, AECI, Sasol Synthetic Fuels and Samancor Base Metal Refinery. None of these industries utilize groundwater as a resource but they do have localized impacts on the groundwater quality.

1.2.2 Agriculture

Most farm units in the WMA are dependent on groundwater for domestic use and stock watering. No total abstraction volumes are available for this use.

Large to medium scale irrigation takes place in areas underlain by dolomitic aquifers (Mooi key area). Abstraction volumes from these aquifers will be confirmed once the WARMS verification process is completed.

Some small-scale irrigation also takes place from Karoo aquifers where localized aquifer conditions are favourable.

1.2.3 Domestic

Little information is available on the informal use of water, such as from boreholes in the rural areas. Groundwater is mostly used by rural communities for domestic use and for animal drinking.

Smaller towns are often dependent on over-exploited low yielding fissured rock aquifers (e.g. Karoo aquifers) but no data is available.

Historically Rand Water utilized groundwater from the Zuurbekom Dolomitic Compartment for domestic supply of the urban areas of the Witwatersrand. This water was of such good quality that it did not require any purification. When the water from the Zuurbekom Compartment could no longer supply enough water for the growing population of the Witwatersrand, the Vaal River, to the south of Johannesburg, was chosen as a new water source. Currently approximately 12 MI/day (Keet, 2003) is still pumped by Rand Water for domestic supply from the compartment.

The following table represents groundwater use in the Upper Vaal WMA according to Statistics South Africa (SSA, 2000).

Table 1: Average groundwater use (millions of cubic metres) (From SSA, 2000)

Year	Rural Domestic	Rural Livestock	Rural Households	Total
1991-2000	5,7	36,9	3,7	46,3
Note: Rural Households represents a groundwater scheme in the Zuurbekom area delivering groundwater to a semi-rural area.				

Private boreholes in urban areas are often utilized for garden irrigation and domestic uses such as filling of swimming pools, etc. No data is available on the abstraction volumes or the number of boreholes in use in urban areas.

1.3 Groundwater quality in the catchment area

1.3.1 Natural

There is a great variation in geology over the catchments (see Section 2). The dominant geology in this area includes Karoo-sediments, dolomites, Witwatersrand, Venterdorp and other geological types. The dolomites are high-yielding with a Ca-Mg- HCO₃ nature, with low TDS under natural conditions. In the Karoo sediments, the Eccas are often characterised by elevated natural salinity, with higher Na and Cl due to the nature of formation. In the eastern and north-eastern portions of the WMA, these sediments often have high alkalinities. The Beaufort sediments have a similar nature but are most often have lower overall salinities under natural conditions. The statistics as provided by Barnard (2000) are given in Table 2.

Table 2: Mean water quality for different lithologies

Geological Unit	No of Sources	pH	EC	TDS
Chuniespoort Dolomite	223	7.6	63	443
West Rand Group	81	7.2	38	254
Central Rand Group	18	7.3	29	207
Black Reef Formation	52	7.0	34	238
Klipriversberg Group	66	7.6	60	405
Dwyka Group	46	7.6	53	363
Vryheid Formation	125	7.5	57	400
Ecca Group	26	7.7	38	260
Clarens Formation	22	7.8	65	463

1.3.2 Point and diffusive pollution

There are several sources of point and diffuse groundwater pollution in the WMA. These are related to mining (principally gold on the West Rand and East Rand, and coal in the Vaal Basin and Highveld coalfield). Large-scale industrial activity in the Vaal Triangle and the areas south of Johannesburg can also contribute to this form of pollution. In this catchment, a broad encompassing study to highlight all the groundwater related risks is required (Fayazi, 2003).

In the gold mining areas to the west and east similar contaminant problems exist. Due to the pyrite and other sulphide minerals associated with the gold, acid mine drainage phenomena are widespread. This results in elevated sulphate concentrations, high TDS and where insufficient natural buffering is present low pHs. Where this occurs, metals, including heavy metals are mobilised at high concentrations that hold a significant risk to the environment and water users. From this perspective the presence of dolomite acts as a natural buffer to prevent acidity and thereby attenuates metals. This has been commonly observed on the West Rand although on the East Rand a great number of acidic discharges with high metal contents have been observed (Scott, 1995). This neutralisation increases the risks of sinkhole formation, which has been a

prominent groundwater problem on the West Rand. The surface waste deposits (slimes dams and waste rock dumps) pose the most significant long-term risk for continued groundwater contamination, (Scott, 1995, Usher and Scott, 1999). This true for the West Rand, Far West Rand, East Rand and Evander gold mining areas.

An additional problem related to gold mining, is radioactivity. In certain instances the uranium was mined together with the gold, while in others radioactive material has been disposed of with the waste. Uranium mobility is restricted due to the general Eh/pH conditions, which exist, but radioactive pollution is a concern in a band stretching from Carltonville, through the Klipspruit catchments to the East Rand gold mines.

From coal mining, the pollution problems are mostly high sulphates, high TDS and in some cases acidic discharges. The latter have so far only been evident from smaller scale defunct collieries in the east of the area towards Ermelo. Coal mining in this area consists of large-scale underground mining in Secunda with all the Sasol mines, New Denmark near Standerton and Sigma colliery near Sasolburg. In the area to the immediate south of the Vaal River there are two large opencast operations, Wonderwater and New Vaal. Due to their proximity to the Vaal River, groundwater management of these operations is a major consideration in the area.

Grobbelaar et al. (2001) have estimated that post-closure up to 120 Ml/day of mine water will emanate on surface or impact on the shallow aquifers from the Mpumalanga coalmines in the Vaal catchment. At the expected elevated sodium, sulphate and bicarbonate concentrations this could have a significant impact on water quality.

The Secunda/Evander area provides a challenge in the fact that the various mining and disposal areas of the Sasol coalmines and Harmony goldmines overlie each other. Gold tailings overlie parts of the westerly coal operations, while in other areas, proposed coal mining is in the Karoo sediments above the current gold mining workings. Factors such as pumpage costs, waste discharge costs and liability in these areas needs careful management and consideration.

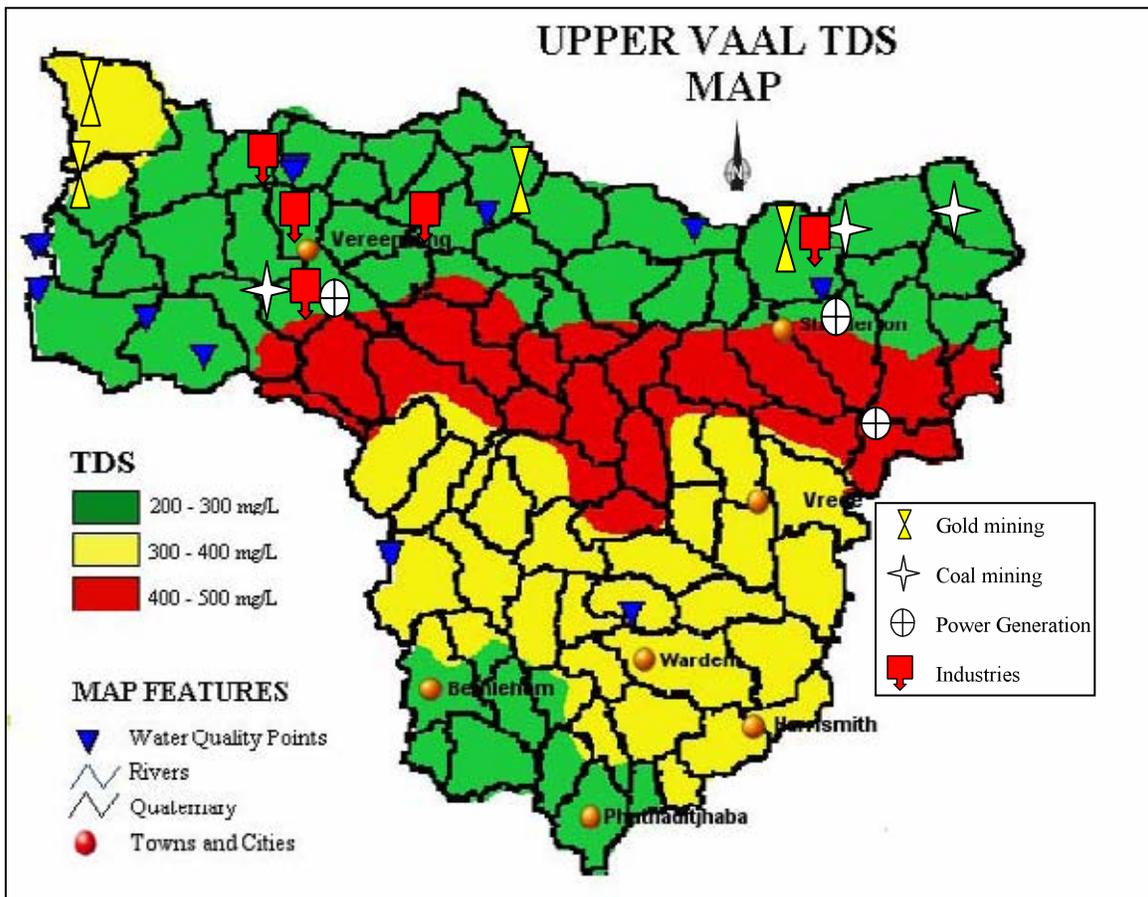


Figure 1 Total dissolved solids and the positions of major impactors

An additional activity of importance in this area is power generation. There are several ESKOM power stations such as Tutuka near Standerton, Majuba near Volksrus, and Letabo near Sasolburg/Vereeniging. Additionally Sasol operations in Sasolburg and Secunda have their own power stations. The major impacts from power stations, in terms of groundwater quality, are associated with the ash disposal and coal stockpiling areas. Hodgson and Krantz (1998) have indicated the major concerns at power stations are high sulphates, elevated TDS and in certain cases very high pH waters. Where these high pH conditions exist, several metals such as Al and Mn can go into solution and are cause for concern.

This catchment is amongst the most high industrialised in the country and the industries are highly diversified. Very little site-specific data is available in the public domain regarding industrial pollution in this catchment. However from the nature of the activities the principle potential problems can be highlighted. Associated with the gold mining activities, several operations reworking old tailings have been established on the West Rand. The processes hold risks regarding cyanides, acids and alkali used in these operations. To the south of Johannesburg, several diversified industries have historically been located. These include operations where explosives were made (risks of especially N- containing pollutants), industries where lead and mercury were products/reagents (e.g. paint manufacture), several mechanical assembly/repair areas where organic solvents are used and have potentially been disposed of. In Sasolburg the industrial activities include petrochemical factories, polymer manufacture, mercury-derivatives, explosives and fertilizer, catalysts manufacturing and the manufacturing of diverse plastics and solvents. Groundwater pollution risks include organic chemicals (LNAPLs and DNAPLs), very high TDS values, nitrates, sulphates, sodium and metals (Cowley, 1999). In Secunda similar pollution concerns exist due to the raw materials and products resulting from the multitude of

processes. In the Vaal Triangle, ISCOR operations are potential sources of extreme salinity, nitrate, sulphate and organic chemicals (including DNAPLs such as PCBs). Several metal refineries are present in the catchment including Impala Platinum, Samancor and Zinkor. These operations all have potential for metal migration and elevated salt loadings with diverse chemicals, depending on the processes used.

Groundwater pollution associated with sanitation is also concern in this area. There is significant informal urbanisation and areas where water-borne sewerage is not present. The groundwater pollution risks in terms of bacteriological and nitrate pollution are especially prominent where such activities are in high recharge areas such as on the dolomitic areas such as in the Klipriver compartment, the Blesbokspruit on the East Rand and the West Rand areas (Barnard, 2000).

Agricultural activities are a source of diffuse water contamination. The contribution of each farm on a local scale is often fairly small but the contribution on a catchment scale these need to be included in assessing any pollution situation. Most findings regarding this issue can only be assessed in a generic way due to the lack of data in the WMA.

Nitrates are the contaminant of highest concern (Conrad et al., 1999), since they are very soluble and do not bind to soils. Nitrates have a high potential to migrate to groundwater. Because they do not evaporate, nitrates/nitrites are likely to remain in water until consumed by plants or other organisms. Generally on a local scale the areas of intense cultivation are the major contributors in terms of inorganic nitrates. The primary inorganic nitrates, which may contaminate drinking water, are potassium nitrate and ammonium nitrate, both of which are widely used as fertilizers. Where feedlots are operated the contribution of organic nitrates to groundwater contamination can be far more problematic. For most farming activities organic nitrate is not a severe problem in South Africa.

Other contaminants of concern are pesticides and herbicides. The contribution of these to groundwater contamination is very difficult to quantify on catchment scale. Site-specific data relating to likely loading/application volumes and history, soil profile and local geohydrology are required.

1.4 Groundwater management and monitoring requirements in the catchment area

1.4.1 Current groundwater monitoring

The current DWAF groundwater monitoring program for WMA is totally inadequate due to a lack of capacity in the Gauteng Regional Geohydrology Section (Fayazi, 2003). There are a number of boreholes (± 200) in the West Rand dolomitic compartments where water level measurements are taken at regular intervals by the Potchefstroom DWAF Hydrology office. The purpose of the monitoring is to assess the influence of the de-watering of the dolomitic compartments due to mining activities. This data is however not processed at regular intervals and a re-evaluation of the network is urgently needed. The Department undertakes no groundwater quality monitoring at this stage.

Compliance groundwater monitoring takes place at most waste sites, industries and mines in terms of licence and permit conditions. However the data is often collected but not evaluated on a regular basis. The need for groundwater objectives (Keet, 2003) has been identified (See Section 1.4.3) as this would make evaluation of this compliance data more consequent.

1.4.2 Management

Management of the groundwater resource in the UVWMA takes place on an adhoc basis (Fayazi, 2003) due to a lack of capacity in the Geohydrology division of the Gauteng Regional office. Only groundwater problems (quantity and quality) that require immediate attention are addressed. An example of this management style is in the Heidelberg district water levels have dropped significantly due to a prolonged dry period and over-abstraction for irrigation. This problem is managed by monitoring water levels and abstraction in the short term. Whenever a groundwater quality problem arises, attention will be given to the problem at the time of identification. This

management style can affect all the water resources negatively in the long run. From the previous sections it can be seen that there are a multitude of impactors, both in terms of quantity and quality, on the groundwater resource and immediate attention should be given to the proper management of this resource. Provision should be made in the regional office for additional groundwater managers/geohydrologists in order to manage the resource in a sustainable manner.

Several studies will be required to properly manage the resource, some of the studies already identified or suggested include:

- To determine the groundwater boundaries for the western basin (Wonderfontein Spruit area) (Keet, 2003)
- To identify all impacts/impactors on the groundwater resource in the WMA (Fayasi, 2003).

In terms of the overall management of water resources in the catchments the regional office has a number of forums to ensure stakeholder participation. Some studies have been completed through these forums for smaller catchments which include groundwater situation assessments e.g. Leeu/Taaibos Spruit. No WUAs exist for groundwater users in the WMA.

Out of a total of 169 license applications received up to date by DWAF Gauteng Regional office, 18 were for abstraction from groundwater resources. The properties for which the license applications are required, are all located in the western portion of the WMA (Mooi and Suikerbosrand key areas) and abstraction will mostly take place from the dolomitic aquifers. Applications are for water uses varies from irrigation of vegetables, chicken farming, bottling of water to mining activities. Preliminary reserves determinations have been completed for the quaternary catchments C22D, C21F and C24A. The other reserve determinations requested have not been completed up to date. License applications for mining related activities are handled on a "compulsory license "principal in order to facilitate better management of the effects of these activities.

Some of the problems encountered with the license applications include the following:

- Due to over abstraction in most dolomitic compartments only the general authorisations can be allowed for new development.
- The right of abstraction from the Zuurbekom compartment belongs to Rand Water, any applications for new use has to be negotiated with them.

1.4.3 Current (quality and quantity) requirements

No formal quality and quantity requirements/objectives have been set in the WMA. The DWAF Gauteng Region have identified an urgent need for groundwater objectives, as these will greatly assist with the evaluation of compliance monitoring data from license/permit holders.

1.5 Poverty eradication and the role groundwater can play in the catchment

Often groundwater is an inexpensive resource for domestic water supply for communities that are located far from existing surface water bulk supply systems. However cognizance has to be taken of the groundwater quality and exploitability when the level of sanitation is considered.

Emerging farmers can also benefit by the exploitation of groundwater for irrigation and livestock farming. The dolomitic aquifers are very well suited for abstraction for large-scale irrigation of crops. Due to the vicinity of major urban centers, vegetable production is a viable option. It is suggested that the allocation of groundwater for this purpose must be explored.

In order to aid the government's initiative with regard to mineral development especially for small-scale mining operations, DWAF could play an active role in the water licensing process.

2 Groundwater according to geolithological units and catchments associated or enclosed with the units (1: 1000 000 geology).

Exploitable aquifers are found in four major Geological Supergroups: The Karoo Supergroup, Transvaal Supergroup, Ventersdorp Supergroup and the Witwatersrand Supergroup (see Figure 2). There are also limited aquifers found in alluvial deposits along streams and rivers.

Karoo sediments of the Eccca and Beaufort Groups, which consist of mainly sandstones, mudstones and shales, cover a large portion of the WMA. The aquifers are secondary aquifers with water associated with fracturing. Groundwater is often associated with dolerite intrusions and the yields are very variable between 0.1 – 10 l/s depending on the type and fracturing of the sediments. Yields are normally higher in the Beaufort group than in the Eccca (Barnard, 2000).

Transvaal, Ventersdorp, Witwatersrand Groups and some basement rocks represent the major geological groups in the north and central portion of the WMA around Johannesburg.

The most significant aquifer in the region is the Malmani dolomite, which forms part of the Chuniespoort Group of the Transvaal Sequence. Although this aquifer extent in terms of outcrop region is small, as a resource this is the most important groundwater related body in the area and constitutes one of the most extensive and heavily utilised groundwater resources within South Africa. Although the dolomite has a relatively low primary permeability, the development of karstic features due to the preferential solution along discontinuities such as joints, faults and bedding planes has served to develop the secondary permeability of the rock mass, particularly in chert-rich units such as the Monte Christo and the Eccles Formations. Groundwater movement within the dolomite aquifer in this area is associated with north-south trending joints and faults, which have experienced preferential solution. The occurrence of groundwater in these rocks occurs in compartments with the Natalspruit and Klipriver compartments prominent to the central part of the WMA, south/east of Johannesburg. Further west a series of north-south trending synite dykes sub-divide the dolomites into the Turffontein, Oberholzer, Bank, Venterspost and Gemsbokfontein compartments; all but the first of these has been heavily affected by mine dewatering. The Zuurbekom compartment is the most widely utilised and has been used as a groundwater resource for bulk water supply for more than a century. Table 3 shows the pre-mining eye or spingflows for the most important compartments; the compartments where mine dewatering has taken place has resulted in eye flows ceasing.

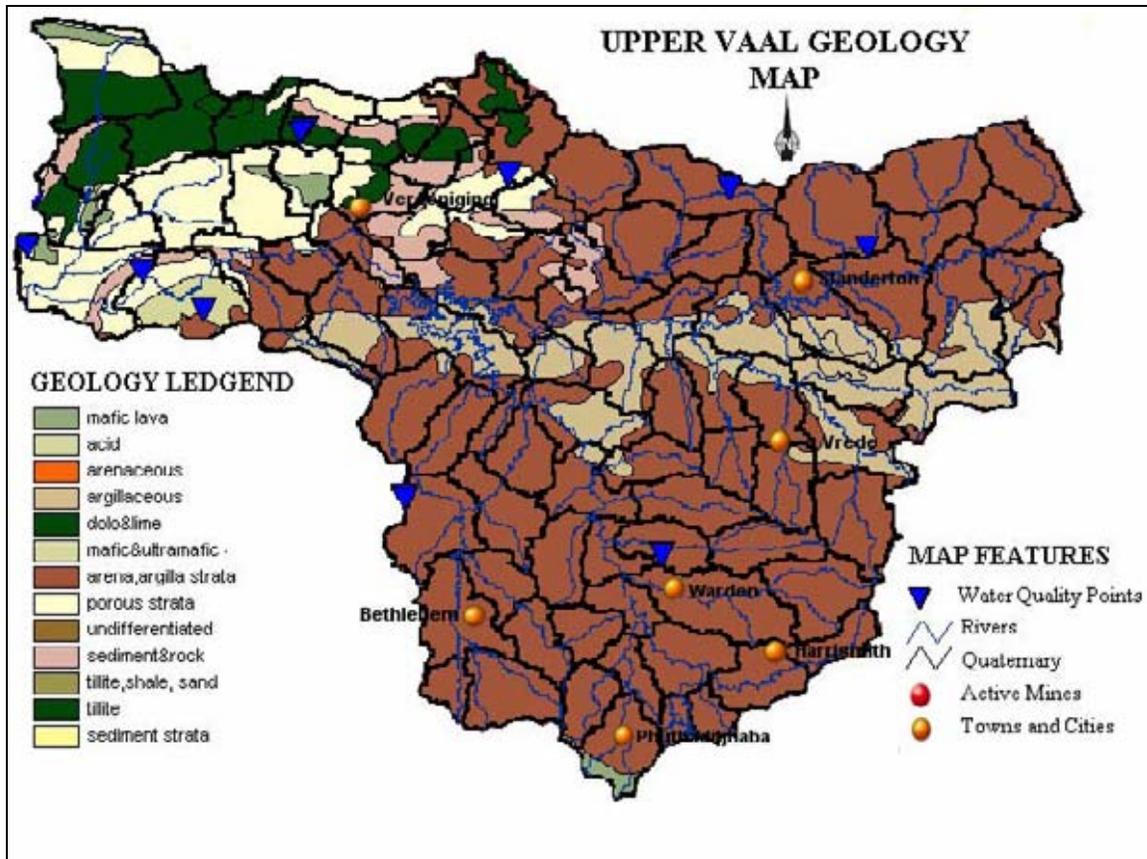


Figure 2: Simplified Geology of the WMA

Table 3: Springs associated with compartmentalising dykes in the West Witwatersrand area (after Scott, 1997)

Compartment	Surface area (m ²)	Name of Spring(s) at outlet of compartment	Average flow of spring before mining (m ³ /day)	Average Volume of Rain on Compartment (m ³ /day)	Proportion of Rainfall that Flows From Eye %
Zuurbekom	100 232 535.6	Klip River	Dry	192 095.21	
Gemsbokfontein	84 951 606.4	Gemsbokfontein	8 637.4	162 809.37	5.31%
Venterspost	54 389 748.0	Venterspost	20 911.6	104 237.71	20.06%
Bank	15 669 4274.0	Wonderfontein	49 096.8	301 163.59	16.30%
Oberholzer	153 845 287.2	Oberholzer	54 097.4	295 687.89	18.30%
Boskop-Turffontein	704 476 736.0	Turffontein	18 411.3	1 349 760.44	5.61%
		Gerhardminnebron	52 733.6		
		Boskop	4 546.0		

Other lower yielding aquifers are found in the Timeball shales and Hekpoort andesites from the Pretoria group. The Ventersdorp andesites (lavas) and Witwatersrand quartzites can, where weathered, be aquifers (Barnard, 2000). Expected borehole yields are summarised from Barnard (2000).

Table 4: Borehole yield statistics (from Barnard, 2000)

Geological Unit	Borehole yield statistics (l/s)						Max Yield
	No of Sources	<0.1	0.1-0.5	0.5-2.0	2.0-5.0	>5.0	
Chuniespoort Dolomite	1230	3.2%	7.2%	23.6%	15.1%	50.5%	126
West Rand Group	234	1.3%	18.8%	44.4%	13.2%	22.2%	30
Central Rand Group	109	4.6%	19.3%	56.8%	11.9%	7.3%	25
Black Reef Formation	63	6.3%	15.8%	50.7%	20.6%	6.3%	6.3
Klipriversberg Group	164	4.8%	37.2%	39.0%	12.8%	6.0%	20
Dwyka Group	35	2.9%	29.4%	44.1%	23.5%	0.0%	4.4
Vryheid Formation	506	17.6%	34.6%	31.2%	10.3%	6.3%	12.6
Ecca Group	185	8.0%	41.6%	33.0%	14.0%	3.2%	9.2
Clarens Formation	110	1.8%	46.4%	45.5%	4.5%	1.8%	8

3 Riverbed Sand Aquifers

Very few riverbed sand aquifers are found in the WMA and no data is available on the characteristics or exploitability. However the general characteristics of riverbed sand aquifers can be summarised (Driscoll, 1986) as:

- Coarse gravels and sands are more typical of alluvial deposits. However, flood plains consist mainly of fine silt.
- Alluvial deposits grain size varies considerably, fine and coarse materials are intermixed. The hydraulic conductivities vary between 10^{-3} to 10^3 m/d and their porosities vary between 25 – 70%. However, flood plain porosities usually range 35 – 50% and the hydraulic conductivities vary between 10^{-8} – 10^{-1} m/d.
- In general riverbed aquifers are high recharge areas and often recharge deeper underlying aquifers. These aquifers are unconfined in nature.
- The surface-water groundwater interaction is often intermittent (depending on the elevation of the water level, groundwater may recharge the surface water body or the surface water may recharge groundwater). This is normally dependent on the rainfall cycle. Therefore boreholes drilled into these aquifers are almost always successful.

Some unlawful diamond diggings with associated groundwater abstraction for process water, takes place in these alluvial aquifers. The DWAF regional office requires license applications for the abstraction of water from these aquifers but often there is very little control over these activities.

4 Ground Water/Surface Water Linkage

This area exhibits certain regions where there is pronounced interaction between surface and groundwater. The two regimes are therefore well-linked and should be integrated to manage any water related issues in these catchments.

Ways in which groundwater and surface waters interact (streams and rivers particularly) include:

- In several of the mining areas, significant amounts of water have been pumped to allow mining to take place. This is most pronounced in the deep gold mining areas of the West Rand and West Wits Line where significant dewatering has had to take place for mining to continue. In the coal mines, a certain amount of dewatering occurs in each mined section. Recycling and reuse of this water occurs as far as possible.
- After post-closure the mines will fill-up with water. Where the conditions are right, the mine water will affect the shallow aquifers and in certain cases will decant on surface. This aspect is of great importance in the long-term and specific water management plans to deal with

these problems need to be put in place. Conversely, once dewatering has stopped, the water lost to the system will decrease. This aspect is very important in this particular WMA where water supplementation plans are designed.

- Natural groundwater flow towards rivers and streams. This base flow can be defined as the part of stream flow that is attributable to long-term discharge of groundwater to the stream. Based flow estimates per quaternary catchment as calculated by Van Tonder and Dennis (2003) are summarised in Table 5.

Table 5: Estimated base flow per quaternary catchment

NAME	BASEFLOW Mm³/a	NAME	BASEFLOW Mm³/a	NAME	BASEFLOW Mm³/a
C11A	6	C21A	4	C81C	3
C11B	4	C21B	3	C81D	2
C11C	4	C21C	3	C81E	5
C11D	3	C21D	3	C81F	12
C11E	8	C21E	4	C81G	5
C11F	6	C21F	3	C81H	2
C11G	2	C21G	3	C81J	2
C11H	6	C22A	5	C81K	2
C11J	6	C22B	3	C81L	8
C11K	2	C22C	4	C81M	8
C11L	6	C22D	3	C82A	5
C11M	4	C22E	4	C82B	4
C12A	2	C22F	3	C82C	2
C12B	2	C22G	5	C82D	4
C12C	3	C22H	3	C82E	5
C12D	5	C22J	4	C82F	3
C12E	2	C22K	3	C82G	4
C12F	4	C23A	1	C82H	5
C12G	3	C23B	3	C83A	7
C12H	1	C23C	4	C83B	2
C12J	1	C23D	8	C83C	6
C12K	2	C23E	12	C83D	3
C12L	4	C23F	21	C83E	3
C13A	6	C23G	8	C83F	5
C13B	4	C23H	6	C83G	5
C13C	7	C23J	3	C83H	4
C13D	7	C23K	1	C83J	1
C13E	4	C23L	5	C83K	3
C13F	4	C81A	6	C83L	4
C13G	3	C81B	6	C83M	6
C13H	3				

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