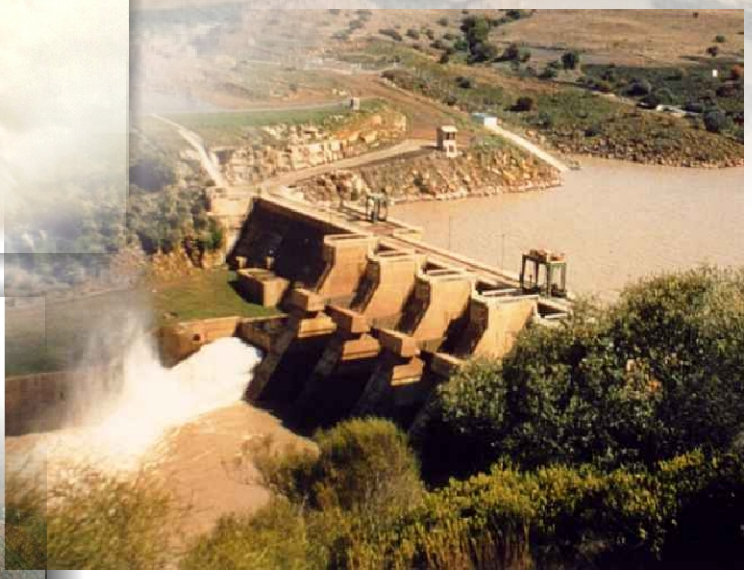
Report Number: P WMA 14/000/00/0304

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

Internal Strategic Perspective
Lower Orange Water Management Area



July 2004

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WATER RESOURCE PLANNING AND CONSERVATION
WRP Consulting Engineers (Pty) Ltd, Reg. No. 98/16706/07

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Department of Water Affairs and Forestry
Directorate National Water Resource Planning

INTERNAL STRATEGIC PERSPECTIVE
FOR THE
LOWER ORANGE WATER MANAGEMENT AREA (WMA No 14)

Title:	*Internal Strategic Perspective for the Lower Orange Water Management Area*
DWAF Report No:	*P WMA 14/000/00/0304*
Consultants:	*PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3*
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Date:	*July 2004*

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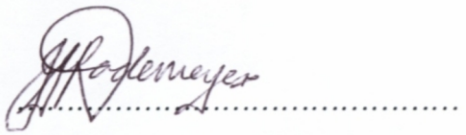

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Internal Strategic Perspective

Lower Orange River Water Management Area

EXECUTIVE SUMMARY

Introduction

The Internal Strategic Perspective (ISP) for the Lower Orange Water Management Area (WMA) is described in this document, and represents the Department of Water Affairs' (DWAF) 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 Lower Orange WMA. The Lower Orange WMA is part of a greater water supply system, including the Upper Orange and Vaal WMAs as well as Lesotho. The strategies for IWRM for the greater system are presented in the Orange and Vaal Overarching ISPs. The Lower Orange ISP should be read in conjunction with the Orange Overarching ISP to get a complete understanding of the strategies and issues.

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

This ISP is a presentation of DWAF's perspectives and plans. External stakeholders have not been involved in its compilation. It is recognised that there are likely to be many comments and valuable suggestions once the document is released, and a process has been put in place to make the ISP widely available and to incorporate improvements in future versions.

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

Overview of the Lower Orange Water Management Area

The Lower Orange WMA is the lowest WMA in the Orange River Basin and as such is affected by upstream activities. The area is arid with rainfall varying from 400 mm in the east to 50 mm on the west coast. The topography of the area is flat with large pans or endoreic areas that do not contribute runoff to the Orange River system.

The Orange River, which forms a green strip in an otherwise arid landscape, also forms the border between South Africa and Namibia over about 550 km to the west of the 20 degree longitude. The Vaal River, the main tributary to the Orange River, has its confluence with the Orange River about 13 km west of Douglas. Other tributaries are the Ongers and Hartebeest Rivers from the south, and the Molopo River and Fish River (Namibia) from the north. There are a number of highly intermittent water courses along the coast which drain directly to the ocean.

Sheep and goat farming is practised over most of the area. Large parts of the WMA also includes conservation areas. Cultivation is restricted to isolated patches where somewhat higher rainfall occurs,

and extensive irrigation is practised in the narrow ribbon of fertile alluvial soils along the Orange River valley. This irrigation is supplied by releases from the Vanderkloof Dam. Large mining operations occur in various parts of the water management area. There are no large urban developments or power stations. Groundwater plays a major role in meeting the water requirements of the towns and rural settlements along the tributaries of the Orange.

Less than 1% of the Gross Domestic Product (GDP) of South Africa originates from the Lower Orange WMA.

The largest economic sectors (in 1997) in the water management, in terms of GGP, were:

- *Government 19,4%*
- *Mining 17,4%*
- *Agriculture 15,9%*
- *Trade 15,1%*

Economic activity is largely concentrated along the Orange River, with several towns located on the banks of the river, and at mining developments.

The two major storage dams Gariep and Vanderkloof, which are both used to supply all the irrigation, urban, mining and environmental requirements along the Lower Orange River are located in the Upper Orange WMA, but are of vital importance to the Lower Orange. There are no large storage dams in the WMA, with only a few smaller dams on some of the main tributaries. These include:

- *Smartt Syndicate Dam on the Ongers River.*
- *Van Wyksvlei on the Carnarvonleegte.*

There are also several diversion weirs of which Boegoeberg is the largest.

Resource Availability

Ninety percent of the runoff generated in the two Orange River WMAs is generated in the Upper Orange WMA. The bulk of the runoff generated in the Lower Orange comes from the Fish River in Namibia (approximately 60% of the Lower Orange runoff), entering the main Orange River close to the river mouth. The bulk of the surface water in the Lower Orange Water Management Area is therefore found in the main stem of the Orange River, with virtually all the surface water generated in the Upper Orange and Vaal WMAs as well as in Lesotho.

Reliable estimates of the surface water resources in the Upper Orange and Vaal River catchment are therefore of extreme importance for the Lower Orange. There is a fairly high confidence in the yield estimates of the surface water in the main system although some of the hydrology is relatively old. The hydrology for the Lower Orange is however not at an acceptable level for the planning or operation of any local water supply schemes outside the Orange River in any of the main tributaries.

Potential for a dam in the Lower Orange River has been identified for the re-regulation of releases from Vanderkloof Dam as well as the storage of flood flows mainly from the Upper Orange and Vaal Rivers and to a lesser extent also from the flows generated in the Lower Orange. This would contribute to the

improved management of the Orange/Vaal River System, and facilitate more water being made available for use. No meaningful potential for surface water regulation exists in the Orange Coastal sub-area.

*Groundwater utilisation is of major importance across wide areas in the Lower Orange WMA and often constitutes the only source of water. It is mainly used for rural domestic supplies, stock watering and water supplies to inland towns. In the Orange Tributaries sub-area (see **Figure C-1** in **Appendix C**) about 60% to 70% of the available water is supplied from groundwater sources. Although proportionately a very small component of the available water in the Orange River sub-area, groundwater also constitutes an important source of water for rural water supplies in this sub-area. Groundwater availability in the Coastal sub-area is very limited.*

Proper management and monitoring of groundwater sources by municipalities and other users are of vital importance. There is a need to provide groundwater information and to create an improved understanding of groundwater at a local level. Municipalities should also investigate groundwater potential outside town boundaries as a possible source.

Water Requirements

Irrigation is by far the dominant water use sector in the Lower Orange WMA, representing 94% of the total requirement for water of 1 130 million m³/a. Water requirements for urban, rural and mining use respectively represent 3%, 2% and 1% of the total water requirements in the water management area.

Virtually all of the irrigation developments are situated along the main stem of the Orange River, being dependent on water abstractions from the river. With most of the irrigation being for high value orchard type crops, much of the water is required at a relatively high assurance of supply.

Most of the urban and mining requirements for water in the water management area are also in the Orange Mainstream sub-area. In addition, water is transferred from the Orange River for urban and mining use to the Orange Coastal sub-area. Water requirements in the Orange Coastal sub-area are very small and are mainly associated with towns such as Springbok, Steinkopf and Port Nolloth as well as the mines in the area.

The growth in water requirements will mainly be to irrigate the additional 4 000 ha earmarked for resource poor farmers. The total projected demand for the year 2025 is 1 174 million m³/a. This includes the 4 000ha for resource poor farmers but shows a slight decrease in the urban and rural requirement.

Water Balance Reconciliation

The Lower Orange WMA is at the bottom end of the extended Orange and Vaal River Systems, and is largely supported by means of releases from Gariep and Vanderkloof dams in the Upper Orange WMA. The water balance for the Lower Orange WMA indicates that 2 083 million m³/a must be transferred from the Upper Orange WMA to keep the Orange sub-area in balance. This transfer, or release obligation, from Vanderkloof Dam will increase to 2 123 million m³/a when the requirement of the 4 000ha for resource poor farmers is included.

A balance also exist with respect to the Coastal sub-area as the transfers from the Orange River are designed to meet the requirements which cannot be supplied from local resources, but no more. The deficit reflected for the Orange Tributaries sub-area is attributable to the requirements for irrigation being

much higher than what can reliably be supplied from the local resources, but where farming practices have been adjusted accordingly.

Shortages in the Upper Orange WMA will directly impact on the Lower Orange WMA and the reader is referred to the Orange River System Overarching ISP for details in this regard. The Overarching ISP also provides a water balance for the Orange River System. This indicates a surplus over the medium term.

For the management of the medium term surplus along the Orange River main stem it should be taken into account that currently (year 2003), none of the irrigation earmarked for resource poor farmers has yet been developed. The temporary surplus can be utilised to maximize hydropower generation at Gariep and Vanderkloof Dams. The availability of the surplus should be assessed and adjusted on an annual basis, by arrangement with Eskom, as part of the annual operating analysis.

*For the management of the long-term water supply along the Orange River main stem, reconciliation can be obtained by means of several options of which all are of an overarching nature and are therefore discussed in detail in the Overarching ISP (**DWAF, 2004a**). The options are briefly listed below:*

- *Measures to reduce the operating losses.*
- *Water conservation and demand management measures.*
- *Vanderkloof Dam, utilising the lower level storage.*
- *Boskraai Dam upstream of Gariep Dam.*
- *Possible developments from Lesotho Lowlands Study.*
- *Possible options that are currently investigated in the Lower Orange River Management Study.*

The measures of reconciling the water balance in catchments off the Orange River main stem should include the following:

- *Implement water conservation and demand management measures as a first option to extend the supply capability of existing water resources. Any new development should also implement sound water conservation and demand management practices.*
- *Investigate the utilisation of local water resources, particularly groundwater. In terms of the NWA, exploration investigations for groundwater and surface water can also take place on private land surrounding towns.*

Detailed assessments of local water balances and reconciliation measures will be the responsibility of the Local Authorities with support (on request) by the DWAF.

Water Quality

Both the flow regime and water quality in the Orange River have been severely impacted upon by extensive upstream developments. Salinity in the Orange River has increased due to the transfer of high quality water out of the Orange River (in Lesotho and the Upper Orange WMA) and as a result of high salinity irrigation return flows along the Orange River. Poor quality water from the Vaal River, which contains a high proportion of irrigation return flows as well as treated urban effluent, also enters the Orange. Salinity is at present still moderate along the main stem of the Orange River. Deterioration can be expected with increased upstream irrigation and the situation must be closely monitored.

There are algal blooms experienced in the main stem due to a combination of irrigation return flows, diffuse sources, and poor quality water from the upstream Vaal WMAs. These algal blooms are potentially toxic and very dangerous to both aquatic and human health. DWAF has instituted a monitoring programme, with communication and management protocols to handle toxic blooms. This remains a very serious risk. Studies and monitoring programmes are underway to understand the current algae behaviour.

Groundwater quality varies from good to unacceptable in terms of potable standards. The groundwater quality is one of the main factors affecting the development of available groundwater resources. Although there are numerous problems associated with water quality, some of which are easily corrected, total dissolved solids (TDS), nitrates (NO3 as N) and fluorides (F) represent the majority of serious water quality problems that occur.

Water quality issues that need to be addressed include diffuse pollution sources from agriculture, management of local sanitation problems at small towns, and the algae problem on the Orange River main stem.

Ecological Reserve Determination

Water to meet the ecological requirements of the Orange River, including the estuary is currently released from Vanderkloof Dam, located in the Upper Orange WMA. This is based on a preliminary determinationof the ecological requirements from the ORRS. Winter flows at the mouth are too high and prevent the natural closure of the mouth during the winter months. This is due to the hydropower releases made by Eskom during winter, utilising the current surplus in the system. This surplus is expected to disappear over the next 5 years, which will resolve the current problem.

A comprehensive Reserve has however not been determined for the Orange River main stem. Preliminary estimations of the environmental requirements as part of the current Lower Orange Management Study (LORMS) study are showing significantly higher requirements for the environment than those obtained from the ORRS, suggesting that the comprehensive Reserve might have a significant impact on the available water resources. There is no accurate gauging of the flow reaching the Orange River Mouth, making it extremely difficult to manage these environmental flow requirements.

The preliminary determination from the ORRS will be used for the main stem of the Orange River until better estimates have been determined for the Orange River and the main tributaries. The Orange River Reserve will have to be determined in close co-operation with the Vaal River Reserve Determination.

System Management

The management of the Overarching Orange River System is undertaken at the National Level. (See Orange River System Overarching ISP for detail). It may be possible to improve system operating rules to better meet the ecological flow pattern required at the Orange River Mouth. Releases may also serve to control the algal blooms that develop in the lower reaches of the Orange. This will receive attention in the Integrated Water Quality Management Studies of the Orange and Vaal River.

Monitoring and Information Systems

Studies have highlighted the need to expand the monitoring network to include more gauges to determine river losses, bulk distribution system losses, track water requirements and include bio-monitoring to assist with the determination and implementation of the ecological Reserve.

The following weak points with regards to the monitoring and information management were identified:

- *Limited, almost no observed data available with regards to the actual irrigation water use.*
- *The existing monitoring programme of the algal blooms in the lower reaches of the Orange River is inadequate.*
- *A flow gauging weir is needed on the Orange River at the mouth to determine operating losses and to verify the supply to the estuary ecological*
- *Problems are experienced with water quality data, which resulted in difficulties with regards to the previous calibration of the salinity model.*
- *Groundwater monitoring programme need to be expanded.*

Institutional Development and Support

On national level, co-operative governance (i.e. liaison and integration of planning between government departments, district and local authorities) needs to be factored into the overall integrated water resources management arena, to ensure a compounded benefit to all users in the catchment. The existing Departmental and international communication systems should be used to keep track of the proposed water resource developments and land use planning as they affect water quality and erosion sedimentation.

A communication process has been started in the WMA to educate, inform and build capacity as regards the establishment of the CMA. This process will be continued with the development of forums and structures, which will form the basis for the CMA.

The Lower Orange River Remediation Forum (LORRF), which is the communication body established to assist with the management of the toxic algae blooms and microbiological problems associated with the Orange River main stem, will be continued. The communication and monitoring systems will be expanded where necessary.

Useful to this communication process between the parties are the WSDPs as prepared by the Municipalities as requested by DWAF, and the ISP documents prepared by the DWAF.

ISP Implementation Strategy

The ISP is intended to act as DWAFs perspective on how the Lower Orange WMA water resources should be managed. The ISP will 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 suggested improvements 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

Lower Orange Water Management Area

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List of Acronyms

Acronym	Meaning
BPs	**Business Plans**
CCAW	**Co-ordinating Committee for Agriculture and Water**
CEIMP	**Consolidated Environmental Implementation and Management Plan**
CMA	**Catchment Management Agency**
CMS	**Catchment Management Strategy**
DWAF	**Department of Water Affairs and Forestry**
DPLG	**Department of Provincial and Local Government**
ECA	**Environmental Conservation Act**
EFR	**Environmental Flow Requirement**
EIMP	**Environmental Implementation and Management Plan**
EMPR	**Environmental Management Programme Report**
GDP	**Gross Domestic Product**
GGP	**Gross Geographic Product**
IAC	**Irrigation Action Committee**
IB	**Irrigation Board**
IDP	**Integrated Development Plan**
IFR	**Instream Flow Requirement**
ISP	**Internal Strategic Perspective**
IWRM	**Integrated Water Resource Management**
IWRP	**Integrated Water Resource Planning**
LHWP	**Lesotho Highlands Water Project**
LORMS	**Lower Orange River Management Study**
LORRF	**Lower Orange River Remediation Forum**
MIG	**Municipal Infrastructure Grant**
MITT	**Municipal Infrastructure Task Team**
MAR	**Mean Annual Runoff**
NEMA	**National Environmental Management Act**
NGDB	**National Groundwater Data Base**
NWA	**National Water Act**
NWRS	**National Water Resource Strategy**
ORASECOM	**Orange Senqu River Commission**
ORRS	**Orange River Development Project Replanning Study**
ORS	**Orange River System**
PDI	**Previously Disadvantaged Individual**
RO	**Regional Office**
SAPWAT	**Irrigation Requirements and Scheduling Strategies SA**
TDS	**Total dissolved solids**
TFCP	**Trans Frontier Conservation Park**
URV	**Unit Reference Value**
VAPS	**Vaal Augmentation Planning Study**
VRSAU	**Vaal River System Analysis Update Study**
WARMS	**Water Registration Management System**
WDM	**Water Demand Management**
WC	**Water Conservation**
WCDM	**Water Conservation and Demand Management**
WMA	**Water Management Area**
WQO	**Water Quality Objectives**
WR90	**Water Resources 1990 Project**
WSA	**Water Service Authority**
WSAM	**Water Situation Assessment Model**
WRC	**Water Research Commission**

Acronym	Meaning
WRSA	**Water Resources Situation Assessment**
WRSAS	**Water Resources Situation Assessment Study**
WRPM	**Water Resources Planning Model**
WRYM	**Water Resources Yield Model**
WSDP	**Water Services Development Plan**
WSP	**Water Services Plan**
WUA	**Water User Association**

GLOSSARY OF TERMS

AQUIFER	A saturated permeable geologic unit that can transmit significant (economically useful) quantities of water under ordinary hydraulic gradients. (Specific geologic materials are not innately defined as aquifers and aquitards, but within the context of the stratigraphic sequence in the subsurface area of interest.)
AQUICLUDE	A geologic unit that cannot transmit significant (economically useful) quantities of water under ordinary hydraulic gradients. (Very few natural geologic materials are considered aquicludes.)
AQUITARD	A saturated, relatively lower permeability geologic unit within a stratigraphic sequence relative to the aquifer of interest. (This terminology is used much more frequently in practice than aquiclude, in recognition of the rarity of natural aquicludes.)
ASSURANCE OF SUPPLY	The reliability at which a specified quantity of water can be provided, usually expressed either as a percentage or as a risk. For example "98% reliability" means that, over a long period of time, the specified quantity of water can be supplied for 98% of the time, and less for the remaining 2%. Alternatively, this situation may be described as a "1 in 50 year risk of failure" meaning that, on average, the specified quantity of water will fail to be provided in 1 year in 50 years, or 2% of time.
BASIN	The area of land that is drained by a large river, or river system.
BIOTA	A collective term for all the organisms (plants, animals, fungi, bacteria) in an ecosystem.
CATCHMENT	The area of land drained by a river. The term can be applied to a stream, a tributary of a larger river or a whole river system.
COMMERCIAL FARMING	Large scale farming, the products of which are normally sold for profit.
COMMERCIAL FORESTS	Forests that are cultivated for the commercial production of wood or paper products.
CONDENSATION	The process whereby water is changed from a gas (water vapor) into a liquid.
CONFINED AQUIFER	An aquifer that is physically located between two aquitards. The water level in a well tapping a confined aquifer usually rises above the level of the aquifer.
CONTAMINANT	Any physical, chemical, biological, or radiological substance or matter in the water.
DEFICIT	Describes the situation where the availability of water at a particular assurance of supply is less than the unrestricted water requirement.

DISCHARGE AREA	The area or zone where groundwater emerges from below the surface. The outflow maybe into a stream, lake, spring, wetland, etc.
ECOLOGICAL IMPORTANCE	A measure of the extent to which a particular species, population or process contributes towards the healthy functioning of an ecosystem. Important aspects include habitat diversity, biodiversity, the presence of unique, rare or endangered biota or landscapes, connectivity, sensitivity and resilience. The functioning of the ecosystem refers to natural processes.
ENDOREIC AREA	Areas from which no runoff reaches the rivers. These areas typically includes pan areas where the runoff generated flows into large pans from where it evaporates whit no water entering the natural streams.
ENVIRONMENTALLY SENSITIVE AREA	A fragile ecosystem, which will be maintained only by conscious attempts to protect it.
FORMAL IRRIGATION SCHEME	The term applies to a scheme where water for irrigation purposes is stored in a dam controlled by DWAF or an Irrigation Board and supplied in pre-determined quotas to irrigators registered under the scheme.
GREY WATER	Any water that has been used in the home, such as water from the bath, shower, washing machine, and bathroom sink, but not from toilets and the kitchen sink, is referred to as "grey water". Grey water can be used for other applications around the home, such as garden irrigation.
GROUNDWATER	Water in the sub-surface, which is beneath the water table, and thus present within the saturated zone. In contrast, to water present in the unsaturated or vadose zone which is referred to as soil moisture.
HYDROLOGY	Hydrology refers primarily to the natural flow sequences that represent the monthly rainfall runoff generated from all the selected sub-catchments within a water supply system as well as the matching rainfall and evaporation data. Along with the natural flow, rainfall and evaporation data, the diffuse demand files and other water requirements representative of all the users in the system are in most cases included.
HYDRAULIC GRADIENT	The difference in hydraulic head between two measuring points within a porous medium, divided by the distance between the two points.
HYDRAULIC HEAD	The fluid potential for flow through porous media largely comprised of pressure head and elevation head. This satisfies the definition of potential in that it is a physical quantity capable of measurement (such as with manometers, piezometers, or wells tapping the porous medium), where flow always occurs from regions of higher values to regions of lower values.
INTERBASIN TRANSFER	Water transferred from one WMA to another.

MEAN ANNUAL RUNOFF	Frequently abbreviated to MAR, this is the long-term mean annual flow calculated for a specified period of time, at a particular point along a river and for a particular catchment and catchment development condition. In this report, the MARs are based on the 70-year period October 1920 to September 1990 inclusive.
NON-POINT SOURCE OF POLLUTION	Contaminates found in water from a source that cannot be specifically defined. For example contamination resulting from municipal runoff or agricultural infiltration.

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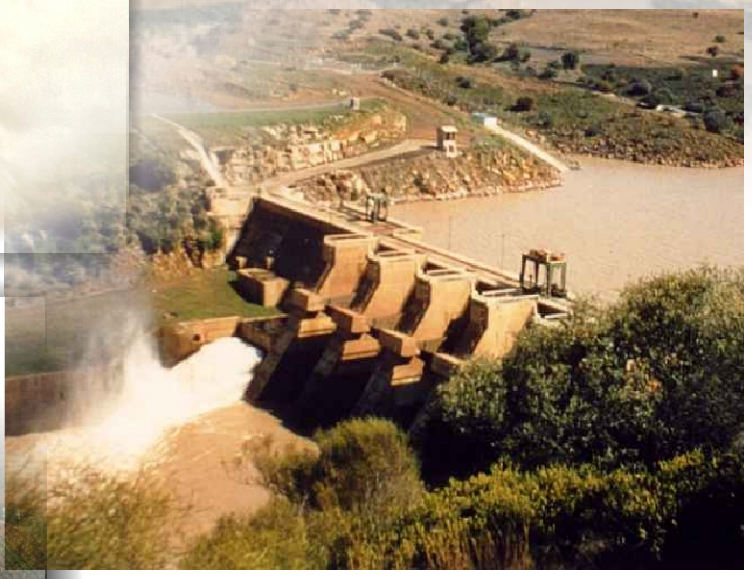

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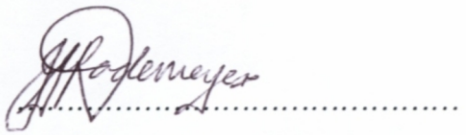

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- Internal Strategic Perspective for the Orange River System: Overarching (Report No: P RSA D000/00/0104)

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Internal Strategic Perspective

Lower Orange River Water Management Area

EXECUTIVE SUMMARY

Introduction

The Internal Strategic Perspective (ISP) for the Lower Orange Water Management Area (WMA) is described in this document, and represents the Department of Water Affairs' (DWAF) 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 Lower Orange WMA. The Lower Orange WMA is part of a greater water supply system, including the Upper Orange and Vaal WMAs as well as Lesotho. The strategies for IWRM for the greater system are presented in the Orange and Vaal Overarching ISPs. The Lower Orange ISP should be read in conjunction with the Orange Overarching ISP to get a complete understanding of the strategies and issues.

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

This ISP is a presentation of DWAF's perspectives and plans. External stakeholders have not been involved in its compilation. It is recognised that there are likely to be many comments and valuable suggestions once the document is released, and a process has been put in place to make the ISP widely available and to incorporate improvements in future versions.

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

Overview of the Lower Orange Water Management Area

The Lower Orange WMA is the lowest WMA in the Orange River Basin and as such is affected by upstream activities. The area is arid with rainfall varying from 400 mm in the east to 50 mm on the west coast. The topography of the area is flat with large pans or endoreic areas that do not contribute runoff to the Orange River system.

The Orange River, which forms a green strip in an otherwise arid landscape, also forms the border between South Africa and Namibia over about 550 km to the west of the 20 degree longitude. The Vaal River, the main tributary to the Orange River, has its confluence with the Orange River about 13 km west of Douglas. Other tributaries are the Ongers and Hartebeest Rivers from the south, and the Molopo River and Fish River (Namibia) from the north. There are a number of highly intermittent water courses along the coast which drain directly to the ocean.

Sheep and goat farming is practised over most of the area. Large parts of the WMA also includes conservation areas. Cultivation is restricted to isolated patches where somewhat higher rainfall occurs,

and extensive irrigation is practised in the narrow ribbon of fertile alluvial soils along the Orange River valley. This irrigation is supplied by releases from the Vanderkloof Dam. Large mining operations occur in various parts of the water management area. There are no large urban developments or power stations. Groundwater plays a major role in meeting the water requirements of the towns and rural settlements along the tributaries of the Orange.

Less than 1% of the Gross Domestic Product (GDP) of South Africa originates from the Lower Orange WMA.

The largest economic sectors (in 1997) in the water management, in terms of GGP, were:

- *Government 19,4%*
- *Mining 17,4%*
- *Agriculture 15,9%*
- *Trade 15,1%*

Economic activity is largely concentrated along the Orange River, with several towns located on the banks of the river, and at mining developments.

The two major storage dams Gariep and Vanderkloof, which are both used to supply all the irrigation, urban, mining and environmental requirements along the Lower Orange River are located in the Upper Orange WMA, but are of vital importance to the Lower Orange. There are no large storage dams in the WMA, with only a few smaller dams on some of the main tributaries. These include:

- *Smartt Syndicate Dam on the Ongers River.*
- *Van Wyksvlei on the Carnarvonleegte.*

There are also several diversion weirs of which Boegoeberg is the largest.

Resource Availability

Ninety percent of the runoff generated in the two Orange River WMAs is generated in the Upper Orange WMA. The bulk of the runoff generated in the Lower Orange comes from the Fish River in Namibia (approximately 60% of the Lower Orange runoff), entering the main Orange River close to the river mouth. The bulk of the surface water in the Lower Orange Water Management Area is therefore found in the main stem of the Orange River, with virtually all the surface water generated in the Upper Orange and Vaal WMAs as well as in Lesotho.

Reliable estimates of the surface water resources in the Upper Orange and Vaal River catchment are therefore of extreme importance for the Lower Orange. There is a fairly high confidence in the yield estimates of the surface water in the main system although some of the hydrology is relatively old. The hydrology for the Lower Orange is however not at an acceptable level for the planning or operation of any local water supply schemes outside the Orange River in any of the main tributaries.

Potential for a dam in the Lower Orange River has been identified for the re-regulation of releases from Vanderkloof Dam as well as the storage of flood flows mainly from the Upper Orange and Vaal Rivers and to a lesser extent also from the flows generated in the Lower Orange. This would contribute to the

improved management of the Orange/Vaal River System, and facilitate more water being made available for use. No meaningful potential for surface water regulation exists in the Orange Coastal sub-area.

*Groundwater utilisation is of major importance across wide areas in the Lower Orange WMA and often constitutes the only source of water. It is mainly used for rural domestic supplies, stock watering and water supplies to inland towns. In the Orange Tributaries sub-area (see **Figure C-1** in **Appendix C**) about 60% to 70% of the available water is supplied from groundwater sources. Although proportionately a very small component of the available water in the Orange River sub-area, groundwater also constitutes an important source of water for rural water supplies in this sub-area. Groundwater availability in the Coastal sub-area is very limited.*

Proper management and monitoring of groundwater sources by municipalities and other users are of vital importance. There is a need to provide groundwater information and to create an improved understanding of groundwater at a local level. Municipalities should also investigate groundwater potential outside town boundaries as a possible source.

Water Requirements

Irrigation is by far the dominant water use sector in the Lower Orange WMA, representing 94% of the total requirement for water of 1 130 million m³/a. Water requirements for urban, rural and mining use respectively represent 3%, 2% and 1% of the total water requirements in the water management area.

Virtually all of the irrigation developments are situated along the main stem of the Orange River, being dependent on water abstractions from the river. With most of the irrigation being for high value orchard type crops, much of the water is required at a relatively high assurance of supply.

Most of the urban and mining requirements for water in the water management area are also in the Orange Mainstream sub-area. In addition, water is transferred from the Orange River for urban and mining use to the Orange Coastal sub-area. Water requirements in the Orange Coastal sub-area are very small and are mainly associated with towns such as Springbok, Steinkopf and Port Nolloth as well as the mines in the area.

The growth in water requirements will mainly be to irrigate the additional 4 000 ha earmarked for resource poor farmers. The total projected demand for the year 2025 is 1 174 million m³/a. This includes the 4 000ha for resource poor farmers but shows a slight decrease in the urban and rural requirement.

Water Balance Reconciliation

The Lower Orange WMA is at the bottom end of the extended Orange and Vaal River Systems, and is largely supported by means of releases from Gariep and Vanderkloof dams in the Upper Orange WMA. The water balance for the Lower Orange WMA indicates that 2 083 million m³/a must be transferred from the Upper Orange WMA to keep the Orange sub-area in balance. This transfer, or release obligation, from Vanderkloof Dam will increase to 2 123 million m³/a when the requirement of the 4 000ha for resource poor farmers is included.

A balance also exist with respect to the Coastal sub-area as the transfers from the Orange River are designed to meet the requirements which cannot be supplied from local resources, but no more. The deficit reflected for the Orange Tributaries sub-area is attributable to the requirements for irrigation being

much higher than what can reliably be supplied from the local resources, but where farming practices have been adjusted accordingly.

Shortages in the Upper Orange WMA will directly impact on the Lower Orange WMA and the reader is referred to the Orange River System Overarching ISP for details in this regard. The Overarching ISP also provides a water balance for the Orange River System. This indicates a surplus over the medium term.

For the management of the medium term surplus along the Orange River main stem it should be taken into account that currently (year 2003), none of the irrigation earmarked for resource poor farmers has yet been developed. The temporary surplus can be utilised to maximize hydropower generation at Gariep and Vanderkloof Dams. The availability of the surplus should be assessed and adjusted on an annual basis, by arrangement with Eskom, as part of the annual operating analysis.

*For the management of the long-term water supply along the Orange River main stem, reconciliation can be obtained by means of several options of which all are of an overarching nature and are therefore discussed in detail in the Overarching ISP (**DWAF, 2004a**). The options are briefly listed below:*

- *Measures to reduce the operating losses.*
- *Water conservation and demand management measures.*
- *Vanderkloof Dam, utilising the lower level storage.*
- *Boskraai Dam upstream of Gariep Dam.*
- *Possible developments from Lesotho Lowlands Study.*
- *Possible options that are currently investigated in the Lower Orange River Management Study.*

The measures of reconciling the water balance in catchments off the Orange River main stem should include the following:

- *Implement water conservation and demand management measures as a first option to extend the supply capability of existing water resources. Any new development should also implement sound water conservation and demand management practices.*
- *Investigate the utilisation of local water resources, particularly groundwater. In terms of the NWA, exploration investigations for groundwater and surface water can also take place on private land surrounding towns.*

Detailed assessments of local water balances and reconciliation measures will be the responsibility of the Local Authorities with support (on request) by the DWAF.

Water Quality

Both the flow regime and water quality in the Orange River have been severely impacted upon by extensive upstream developments. Salinity in the Orange River has increased due to the transfer of high quality water out of the Orange River (in Lesotho and the Upper Orange WMA) and as a result of high salinity irrigation return flows along the Orange River. Poor quality water from the Vaal River, which contains a high proportion of irrigation return flows as well as treated urban effluent, also enters the Orange. Salinity is at present still moderate along the main stem of the Orange River. Deterioration can be expected with increased upstream irrigation and the situation must be closely monitored.

There are algal blooms experienced in the main stem due to a combination of irrigation return flows, diffuse sources, and poor quality water from the upstream Vaal WMAs. These algal blooms are potentially toxic and very dangerous to both aquatic and human health. DWAF has instituted a monitoring programme, with communication and management protocols to handle toxic blooms. This remains a very serious risk. Studies and monitoring programmes are underway to understand the current algae behaviour.

Groundwater quality varies from good to unacceptable in terms of potable standards. The groundwater quality is one of the main factors affecting the development of available groundwater resources. Although there are numerous problems associated with water quality, some of which are easily corrected, total dissolved solids (TDS), nitrates (NO3 as N) and fluorides (F) represent the majority of serious water quality problems that occur.

Water quality issues that need to be addressed include diffuse pollution sources from agriculture, management of local sanitation problems at small towns, and the algae problem on the Orange River main stem.

Ecological Reserve Determination

Water to meet the ecological requirements of the Orange River, including the estuary is currently released from Vanderkloof Dam, located in the Upper Orange WMA. This is based on a preliminary determinationof the ecological requirements from the ORRS. Winter flows at the mouth are too high and prevent the natural closure of the mouth during the winter months. This is due to the hydropower releases made by Eskom during winter, utilising the current surplus in the system. This surplus is expected to disappear over the next 5 years, which will resolve the current problem.

A comprehensive Reserve has however not been determined for the Orange River main stem. Preliminary estimations of the environmental requirements as part of the current Lower Orange Management Study (LORMS) study are showing significantly higher requirements for the environment than those obtained from the ORRS, suggesting that the comprehensive Reserve might have a significant impact on the available water resources. There is no accurate gauging of the flow reaching the Orange River Mouth, making it extremely difficult to manage these environmental flow requirements.

The preliminary determination from the ORRS will be used for the main stem of the Orange River until better estimates have been determined for the Orange River and the main tributaries. The Orange River Reserve will have to be determined in close co-operation with the Vaal River Reserve Determination.

System Management

The management of the Overarching Orange River System is undertaken at the National Level. (See Orange River System Overarching ISP for detail). It may be possible to improve system operating rules to better meet the ecological flow pattern required at the Orange River Mouth. Releases may also serve to control the algal blooms that develop in the lower reaches of the Orange. This will receive attention in the Integrated Water Quality Management Studies of the Orange and Vaal River.

Monitoring and Information Systems

Studies have highlighted the need to expand the monitoring network to include more gauges to determine river losses, bulk distribution system losses, track water requirements and include bio-monitoring to assist with the determination and implementation of the ecological Reserve.

The following weak points with regards to the monitoring and information management were identified:

- *Limited, almost no observed data available with regards to the actual irrigation water use.*
- *The existing monitoring programme of the algal blooms in the lower reaches of the Orange River is inadequate.*
- *A flow gauging weir is needed on the Orange River at the mouth to determine operating losses and to verify the supply to the estuary ecological*
- *Problems are experienced with water quality data, which resulted in difficulties with regards to the previous calibration of the salinity model.*
- *Groundwater monitoring programme need to be expanded.*

Institutional Development and Support

On national level, co-operative governance (i.e. liaison and integration of planning between government departments, district and local authorities) needs to be factored into the overall integrated water resources management arena, to ensure a compounded benefit to all users in the catchment. The existing Departmental and international communication systems should be used to keep track of the proposed water resource developments and land use planning as they affect water quality and erosion sedimentation.

A communication process has been started in the WMA to educate, inform and build capacity as regards the establishment of the CMA. This process will be continued with the development of forums and structures, which will form the basis for the CMA.

The Lower Orange River Remediation Forum (LORRF), which is the communication body established to assist with the management of the toxic algae blooms and microbiological problems associated with the Orange River main stem, will be continued. The communication and monitoring systems will be expanded where necessary.

Useful to this communication process between the parties are the WSDPs as prepared by the Municipalities as requested by DWAF, and the ISP documents prepared by the DWAF.

ISP Implementation Strategy

The ISP is intended to act as DWAFs perspective on how the Lower Orange WMA water resources should be managed. The ISP will 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 suggested improvements 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

Lower Orange Water Management Area

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List of Acronyms

Acronym	Meaning
BPs	**Business Plans**
CCAW	**Co-ordinating Committee for Agriculture and Water**
CEIMP	**Consolidated Environmental Implementation and Management Plan**
CMA	**Catchment Management Agency**
CMS	**Catchment Management Strategy**
DWAF	**Department of Water Affairs and Forestry**
DPLG	**Department of Provincial and Local Government**
ECA	**Environmental Conservation Act**
EFR	**Environmental Flow Requirement**
EIMP	**Environmental Implementation and Management Plan**
EMPR	**Environmental Management Programme Report**
GDP	**Gross Domestic Product**
GGP	**Gross Geographic Product**
IAC	**Irrigation Action Committee**
IB	**Irrigation Board**
IDP	**Integrated Development Plan**
IFR	**Instream Flow Requirement**
ISP	**Internal Strategic Perspective**
IWRM	**Integrated Water Resource Management**
IWRP	**Integrated Water Resource Planning**
LHWP	**Lesotho Highlands Water Project**
LORMS	**Lower Orange River Management Study**
LORRF	**Lower Orange River Remediation Forum**
MIG	**Municipal Infrastructure Grant**
MITT	**Municipal Infrastructure Task Team**
MAR	**Mean Annual Runoff**
NEMA	**National Environmental Management Act**
NGDB	**National Groundwater Data Base**
NWA	**National Water Act**
NWRS	**National Water Resource Strategy**
ORASECOM	**Orange Senqu River Commission**
ORRS	**Orange River Development Project Replanning Study**
ORS	**Orange River System**
PDI	**Previously Disadvantaged Individual**
RO	**Regional Office**
SAPWAT	**Irrigation Requirements and Scheduling Strategies SA**
TDS	**Total dissolved solids**
TFCP	**Trans Frontier Conservation Park**
URV	**Unit Reference Value**
VAPS	**Vaal Augmentation Planning Study**
VRSAU	**Vaal River System Analysis Update Study**
WARMS	**Water Registration Management System**
WDM	**Water Demand Management**
WC	**Water Conservation**
WCDM	**Water Conservation and Demand Management**
WMA	**Water Management Area**
WQO	**Water Quality Objectives**
WR90	**Water Resources 1990 Project**
WSA	**Water Service Authority**
WSAM	**Water Situation Assessment Model**
WRC	**Water Research Commission**

Acronym	Meaning
WRSA	**Water Resources Situation Assessment**
WRSAS	**Water Resources Situation Assessment Study**
WRPM	**Water Resources Planning Model**
WRYM	**Water Resources Yield Model**
WSDP	**Water Services Development Plan**
WSP	**Water Services Plan**
WUA	**Water User Association**

GLOSSARY OF TERMS

AQUIFER	A saturated permeable geologic unit that can transmit significant (economically useful) quantities of water under ordinary hydraulic gradients. (Specific geologic materials are not innately defined as aquifers and aquitards, but within the context of the stratigraphic sequence in the subsurface area of interest.)
AQUICLUDE	A geologic unit that cannot transmit significant (economically useful) quantities of water under ordinary hydraulic gradients. (Very few natural geologic materials are considered aquicludes.)
AQUITARD	A saturated, relatively lower permeability geologic unit within a stratigraphic sequence relative to the aquifer of interest. (This terminology is used much more frequently in practice than aquiclude, in recognition of the rarity of natural aquicludes.)
ASSURANCE OF SUPPLY	The reliability at which a specified quantity of water can be provided, usually expressed either as a percentage or as a risk. For example "98% reliability" means that, over a long period of time, the specified quantity of water can be supplied for 98% of the time, and less for the remaining 2%. Alternatively, this situation may be described as a "1 in 50 year risk of failure" meaning that, on average, the specified quantity of water will fail to be provided in 1 year in 50 years, or 2% of time.
BASIN	The area of land that is drained by a large river, or river system.
BIOTA	A collective term for all the organisms (plants, animals, fungi, bacteria) in an ecosystem.
CATCHMENT	The area of land drained by a river. The term can be applied to a stream, a tributary of a larger river or a whole river system.
COMMERCIAL FARMING	Large scale farming, the products of which are normally sold for profit.
COMMERCIAL FORESTS	Forests that are cultivated for the commercial production of wood or paper products.
CONDENSATION	The process whereby water is changed from a gas (water vapor) into a liquid.
CONFINED AQUIFER	An aquifer that is physically located between two aquitards. The water level in a well tapping a confined aquifer usually rises above the level of the aquifer.
CONTAMINANT	Any physical, chemical, biological, or radiological substance or matter in the water.
DEFICIT	Describes the situation where the availability of water at a particular assurance of supply is less than the unrestricted water requirement.

DISCHARGE AREA	The area or zone where groundwater emerges from below the surface. The outflow maybe into a stream, lake, spring, wetland, etc.
ECOLOGICAL IMPORTANCE	A measure of the extent to which a particular species, population or process contributes towards the healthy functioning of an ecosystem. Important aspects include habitat diversity, biodiversity, the presence of unique, rare or endangered biota or landscapes, connectivity, sensitivity and resilience. The functioning of the ecosystem refers to natural processes.
ENDOREIC AREA	Areas from which no runoff reaches the rivers. These areas typically includes pan areas where the runoff generated flows into large pans from where it evaporates whit no water entering the natural streams.
ENVIRONMENTALLY SENSITIVE AREA	A fragile ecosystem, which will be maintained only by conscious attempts to protect it.
FORMAL IRRIGATION SCHEME	The term applies to a scheme where water for irrigation purposes is stored in a dam controlled by DWAF or an Irrigation Board and supplied in pre-determined quotas to irrigators registered under the scheme.
GREY WATER	Any water that has been used in the home, such as water from the bath, shower, washing machine, and bathroom sink, but not from toilets and the kitchen sink, is referred to as "grey water". Grey water can be used for other applications around the home, such as garden irrigation.
GROUNDWATER	Water in the sub-surface, which is beneath the water table, and thus present within the saturated zone. In contrast, to water present in the unsaturated or vadose zone which is referred to as soil moisture.
HYDROLOGY	Hydrology refers primarily to the natural flow sequences that represent the monthly rainfall runoff generated from all the selected sub-catchments within a water supply system as well as the matching rainfall and evaporation data. Along with the natural flow, rainfall and evaporation data, the diffuse demand files and other water requirements representative of all the users in the system are in most cases included.
HYDRAULIC GRADIENT	The difference in hydraulic head between two measuring points within a porous medium, divided by the distance between the two points.
HYDRAULIC HEAD	The fluid potential for flow through porous media largely comprised of pressure head and elevation head. This satisfies the definition of potential in that it is a physical quantity capable of measurement (such as with manometers, piezometers, or wells tapping the porous medium), where flow always occurs from regions of higher values to regions of lower values.
INTERBASIN TRANSFER	Water transferred from one WMA to another.

MEAN ANNUAL RUNOFF	Frequently abbreviated to MAR, this is the long-term mean annual flow calculated for a specified period of time, at a particular point along a river and for a particular catchment and catchment development condition. In this report, the MARs are based on the 70-year period October 1920 to September 1990 inclusive.
NON-POINT SOURCE OF POLLUTION	Contaminates found in water from a source that cannot be specifically defined. For example contamination resulting from municipal runoff or agricultural infiltration.

CHAPTER 1: BACKGROUND TO THE LOWER ORANGE WMA INTERNAL STRATEGIC PERSPECTIVE

1.1 LOCATION OF THE LOWER ORANGE WMA

Figure 1.1 shows the location of the Lower Orange WMA, which lies predominantly within the Northern Cape, but also occupies small portions of the Western Cape Province.

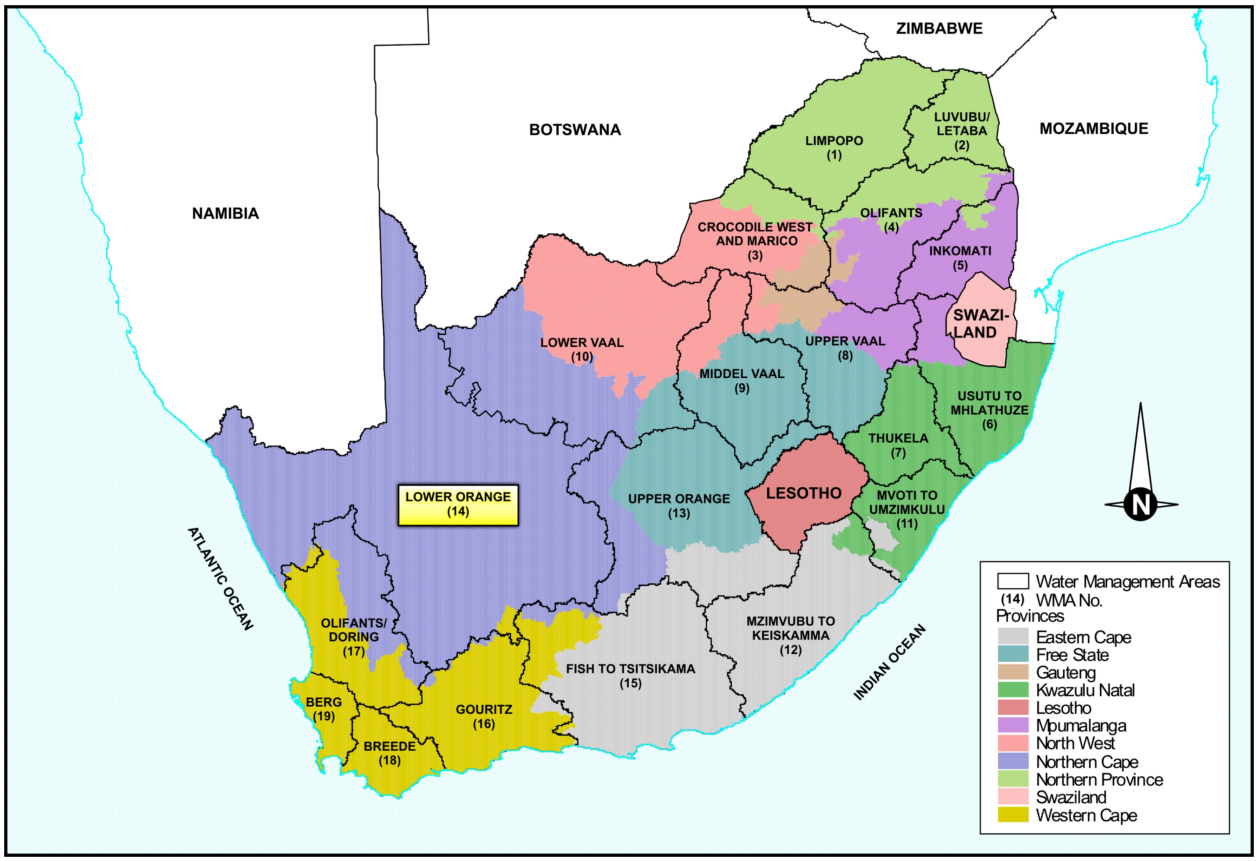

Figure 1.1: Location of the Upper Orange WMA

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, geographically, seasonally and annualy as well as socio-politically.

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

- To achieve equitable access to water. That is, equity of access to water services, to the use of water resources, and to the benefits from the use of water resources.
- To achieve sustainable use of water, by making progressive adjustments to water use to achieve a balance between water availability and legitimate water requirements, and by implementing measures to protect water resources and the natural environment.
- To achieve efficient and effective water use for optimum social and economic benefit.

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

- Water will be regarded as an indivisible national asset. The Government will act as the custodian of the nation's water resources, and its powers in this regard will be exercised as a public trust.
- Water required to meet basic human needs and to maintain environmental sustainability will be guaranteed as a right, whilst water use for all other purposes will be subject to a system of administrative authorisations.
- The responsibility and authority for water resource management will be progressively decentralised by the establishment of suitable regional and local institutions, with appropriate community, racial and gender representation, to enable all interested persons to participate.

1.2.1 The National Water Act (NWA)

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

1.2.2 The National Water Resource Strategy (NWRS)

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

- The National framework for managing water resources.
- The framework for preparation of catchment management strategies in a nationally consistent way.
- Information, in line with current legislation, regarding transparent and accountable public administration.
- The identification of development opportunities and constraints with respect to water availability (quantity and quality).

1.2.3 Catchment Management Strategies (CMS)

The country has been divided into 19 Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level will be achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA will

progressively develop a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA.

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

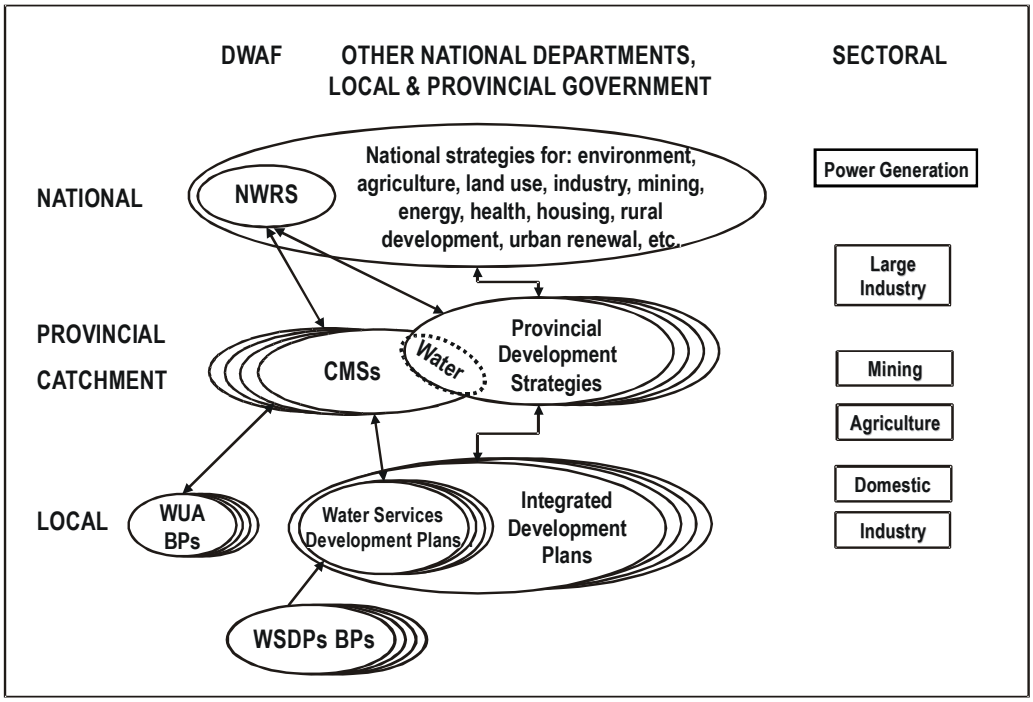

Figure 1.2 : Integrated planning approach at various levels of government in South Africa

1.3 INTERNAL STRATEGIC PERSPECTIVES (ISPs)

1.3.1 The Objectives of the ISP Process

The objective of this ISP is 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 it's management functions to an 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 need to be 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 ISPs for each of the Water Management Areas in the Central Planning Region were preceded by the compilation of an Overarching ISP for the Orange and for the Vaal River

System. The purpose of the Overarching ISP was to develop strategies covering issues related to the entire Orange River System and relates to the interdependency between the Upper and Lower Orange, along with the Vaal River catchment. The overarching ISPs (Orange and Vaal), are similar to the NWRS, in that they guide the management of water resources affecting more than one WMA. The ISPs for each individual WMA fall in the category of a CMS.

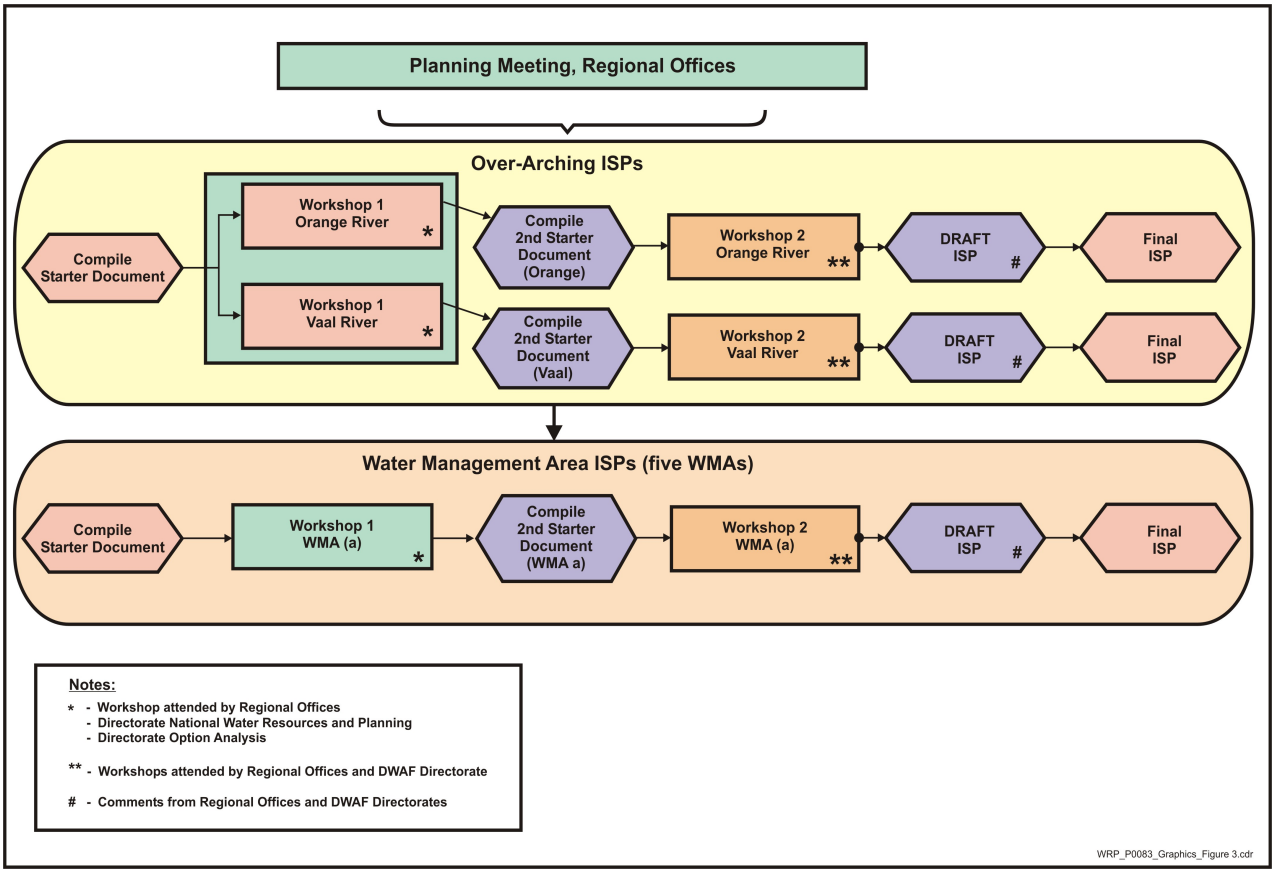

Figure 1.3 : Schematic showing ISP development process

The process for the development of the overarching and the individual ISPs for the Orange River system is shown in **Figure 1.3**. The ISP for the Lower Orange 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 Lower Orange WMA. This was achieved through interviews with individual members of DWAF's Regional Office in Kimberley and Upington 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. Attendees of the first workshop 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 Lower Orange 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. Adopting this procedure means that this ISP remains 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 1.6**).

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. Relevant and readily available, details have however been included where possible. The responsible authority for the further development of each strategy is indicated. For the most part this is 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. The introduction of new strategies also needs to be accommodated. It is suggested that each strategy has a version-control system. The following is necessary:

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

- Ensure consistency between the ISP strategies and national strategies through a regular review-and-update procedure.
- Annually review and ensure consistency and agreement regarding trans-boundary ISP management issues by liasing with the responsible managers of other areas and updating relevant ISP strategies if necessary.
- Annually review the priorities of required management actions and align budgets accordingly.
- Monitor the implementation of the ISP (review actions, progress, implementation and stumbling blocks).
- Incorporate feedback from stakeholders.
- Rigorously apply ISP version control.

Updating and Version Control

The actual frequency of ISP revision will be determined by the number and extent of revisions to management approaches as reflected in Strategy amendments. All updates to this report, particularly with respect to amendment to the Strategies, need to be passed on to and vetted by the Catchment Manager for the Lower Orange WMA. The current incumbent is Ms B Conradie, 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 NWRS contains the best information and knowledge available at the time of its preparation. 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** of the NWRS, 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 Overview Reports". The WMA Overview reports were also finalised with the February 2003 information.

Still deeper in the background lies another set of reports (one per WMA). These are the 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 superseded 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, in some cases, emerged. The level of study has been very detailed and intense for the ISP. This has 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, differing from the NWRS, these discrepancies are carefully explained, as are all other instances of divergence.

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 with the ISP reports published on the Internet and in hardcopy, and presented and discussed at WMA forums. Comments received will be considered and worked into subsequent versions of the ISP on a regular (annual) 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**.

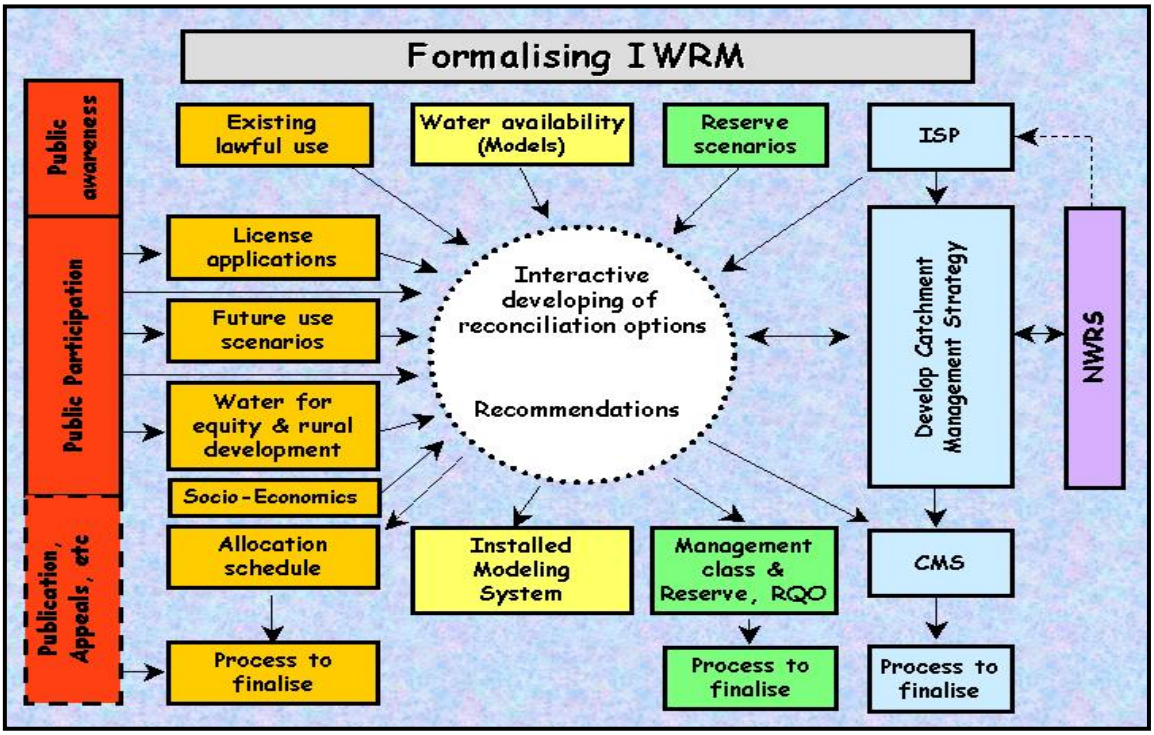

Figure 1.4: Diagram showing DWAF Integrated Water Resources Management approach

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 implementation.

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

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

1.5 CARING FOR THE ENVIRONMENT

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

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

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

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

- The direct impact of physical structures (environmental constraints to construction e.g. of weirs or dams).
- The implications of allocating and licensing water for use. Forestry and irrigation are examples of users where development based on water can mean the transformation of extensive areas of otherwise 'natural' environments.
- The allocation of water for equity. Here we can include approaches towards the application of Schedule 1 Use, General Authorisations, the revitalisation of irrigation schemes, etc.

- Failure to support equity, or appropriate development – noting the consequential impacts of poverty.
- Sanitation systems and the impacts on groundwater quality.
- The implementation of the Reserve.
- The ability to monitor and manage compliance, thus protecting the resource and with it the environment.

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

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

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

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

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

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

1.6 THE SOCIAL ENVIRONMENT

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

Impacts on society are a core element of this ISP, and decisions are often complicated by the risk of unintended consequence. As a typical example the over-zealous implementation of the

ecological Reserve may benefit the river, to the intended benefit of society, but the cost of 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 (**Appendix A**: 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 Gariep Dam for freshening the saline water Fish and Sundays rivers in the Eastern Cape, and of the addition of

freshening releases from Vaal Barrage to bring water back to an acceptable quality has, inter alia, long been standard practice. The consequences of irrigation, the leaching of fertilisers, and more importantly the leaching of salts from deeper soil horizons can render both the lands themselves and the receiving rivers unsuitable for use. Diffuse agricultural 'effluent' may be less visible than direct discharges of sewage or industrial effluent, but are no less pernicious.

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

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

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

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

Actions recommended within the Department include:

- The need to actively workshop the integration process. Resource Management, Planning and Allocations of Groundwater and Surface Water Quantity and Quality.
- The review and incorporation of knowledge from recent Water Research Commission Studies on both radioactivity and nitrates (groundwater quality issues).
- A review of all water quality literature reflecting situational knowledge and understanding within this WMA (and each and every WMA).
- Ensure that Water Quality monitoring is fully integrated into WMA water resources monitoring.
- Refer particularly to strategies 2.2, and 8 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.

See also Groundwater Strategy No 1.1, in **Appendix A** of this ISP.

1.9 PUBLIC RECREATION - THE USE OF DAMS AND RIVERS

The use of water for recreational purposes is one of the 11 water uses regulated in terms of the NWA (Section 21 j). The Department is developing a national policy towards 'Recreation on Dams and Rivers' and this should, in the first instance, be adhered to. Recreational use can take many forms and only occasionally has any direct impact on the water resource. Most

obvious are activities such as power-boating, sailing and swimming which can have quality / pollution impacts. Far more significant in terms of both quantity and quality is the release of water to allow for canoeing and other water sports downstream (The Upper Vaal, Dusi and Fish River canoe marathons being prime examples). These activities can bring very significant economic benefits to the WMAs concerned, and where water releases can be accommodated, particularly through alignment with the needs of the ecological Reserve or other downstream users, then so much the better.

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

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

1.10 CO-OPERATIVE GOVERNANCE – the place of the ISP

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

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CHAPTER 2: BROAD PERSPECTIVE OF THE WATER SITUATION IN THE LOWER ORANGE RIVER WMA AND RELATED WATER RESOURCE MANAGEMENT STRATEGIES

2.1 Introduction

This chapter presents summarised information from the NWRS (**DWAF, 2004c**) and the "Overview of Water Resources Availability and Utilisation" (**DWAF, 2003b**) reports for the Lower Orange River WMA to provide the required background of the water situation in the Orange River catchment. This will enable the reader to better understand the strategies developed through the ISP process. The Orange River Overarching Report (**DWAF, 2004a**) should be read in parallel with this ISP for a full understanding of the overarching strategies, mainly between the Upper and Lower Orange WMA. When more detailed background information is required the reader is referred to the NWRS (**DWAF, 2004c**) chapter 2, and secondly to the "Overview of Water Resources Availability and Utilisation" (**DWAF, 2003a & 2003b**) reports for each WMA. These reports should in general provide sufficient detail for most readers. The reader is also strongly advised to read the overview reports. Even more detail can be obtained from the "Water Resources Situation Assessment Study" (**DWAF, 2002b**) for each Water Management Area.

This chapter is structured to capture the background and related strategies on a logic and descriptive basis. A broad overview of the strategies that were identified for the Lower Orange River WMA is also included, serving as an introduction to the detailed descriptions of the strategies presented in **Appendix A.** The tables in **Appendix A** present the strategies in a structured format to include 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 to label the DWAF directorates responsible for implementation.

The strategies developed in **Appendix A** cover water resource issues and related water management concerns specific to the Lower Orange WMA. Issues applicable to all WMAs have also been raised in the Lower Orange. These have been taken up nationally, and reported on at this level. A National workshop was held in October 2003 and task teams appointed to address these issues and to develop principles, guidelines and strategies as required. 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 coordination.

The development of the strategies has been formulated with the IWRM process in mind (see **Figure 1.4)** and the generic structure, according to which the strategies are presented, follows the broad framework of the National Water Act.

2.2 General Catchment Description

2.2.1 Overview

The Lower Orange WMA is the lowest WMA in the Orange/Vaal River Basin and as such is affected by upstream activities, both in terms of the Upper Orange and the Vaal System. The area is arid with rainfall varying from 400 mm in the east to 50 mm on the west coast. The topography of the area is flat with large pans or endoreic areas that do not contribute runoff to the Orange River system.

The Orange River, which forms a green strip in an otherwise arid landscape, also forms the border between South Africa and Namibia over about 550 km to the west of 20 degrees longitude. The Vaal River, the main tributary to the Orange River, has its confluence with the Orange River about 13 km west of Douglas. Other tributaries are the Ongers and Hartebeest Rivers from the south, and the Molopo River and Fish River (Namibia) from the north. There are a number of highly intermittent water courses along the coast which drain directly to the ocean. Refer to **Figure C1** in **Appendix C** for the location and general layout of the water management area.

2.2.2 Land use and development

The area was initially populated by Bushmen hunters and more recently by sheep-herding Khoikois. Minerals and water from the Orange River were the key elements for economic development in the region, and still remain so. Copper was discovered near Springbok in 1850, which led to the first commercial mine in South Africa. The first diamond in the country was discovered in 1866, when a young boy found a transparent stone on the south bank of the Orange River. The first irrigation scheme of note was built at Upington, which was originally established as a trading station for items such as copper, iron, assegais, ivory, skins and tobacco. Construction of the weir at Boegoeberg for irrigation purposes began in 1906, and in 1914 the first hydro-electric plant on the Orange River was built near Kakamas. Great expansion of irrigation was made possible along the Orange River by the construction of Gariep and Vanderkloof Dams (in the Upper Orange water management area) during the 1970's. Since the early explorations large mining operations, related to the diamonds and other minerals have been established.

From a land use perspective, the water management area still remains almost totally under natural vegetation. Sheep and goat farming is practised over most of the area. Large parts of the WMA also include conservation areas. Cultivation is restricted to isolated patches where somewhat higher rainfall occurs, and irrigation in the narrow ribbon of fertile alluvial soils along the Orange River valley as shown in **Figure C3** in **Appendix C**. Large mining operations occur in various parts of the water management area (some of the diamond mining activities along the coast are not reflected on the map). There are no large urban developments or power stations in the water management area. Due to the arid climate, no afforestation occurs. Invading alien vegetation is found along some tributary water courses and on the banks of the Orange River and is a problem in some localised areas (**DWAF, 2003b**).

The main activities in the WMA are therefore mining and irrigation. Extensive irrigation is practised along the Orange River. This irrigation is supplied with releases from the Vanderkloof and Gariep dams. It is not expected that there will be any significant growth in the water requirements in the WMA. The water availability along the main stem of the Orange depends on

releases from upstream, as the WMA itself generates very little runoff. Groundwater plays a major role in meeting the water requirements of the towns and rural settlements along the tributaries of the Orange although the volumes are not large. The water balance for the WMA shows that supply and demand are currently almost in balance.

Through its interdependence with other water management areas, it is essential that water resource management in the Lower Orange WMA should be well co-ordinated with these water management areas, particularly in the Orange/Vaal Basin, and that it should be viewed in an integrated systems context (See Orange River System Overarching ISP; **DWAF, 2004a**).

2.2.3 Economic Characterisation of the WMA

Less than 1% of the Gross Domestic Product (GDP) of South Africa originates from the Lower Orange WMA. This is the second lowest of all water management areas in the country. The composition of the economy in the WMA in terms of the Gross Domestic Product (GGP) is shown in **Figure 2.1**. The largest economic sectors (in 1997) in the water management, in terms of GGP, were:

- Government 19,4%
- Mining 17,4%
- Agriculture 15,9%
- Trade 15,1%"

(**DWAF, 2003b**)

Economic activity is largely concentrated along the Orange River, with several towns located on the banks of the river, and at mining developments.

There are no large government institutions in the water management area and the importance of the government sector in the regional economy mainly relates to services with respect to the above sectors.

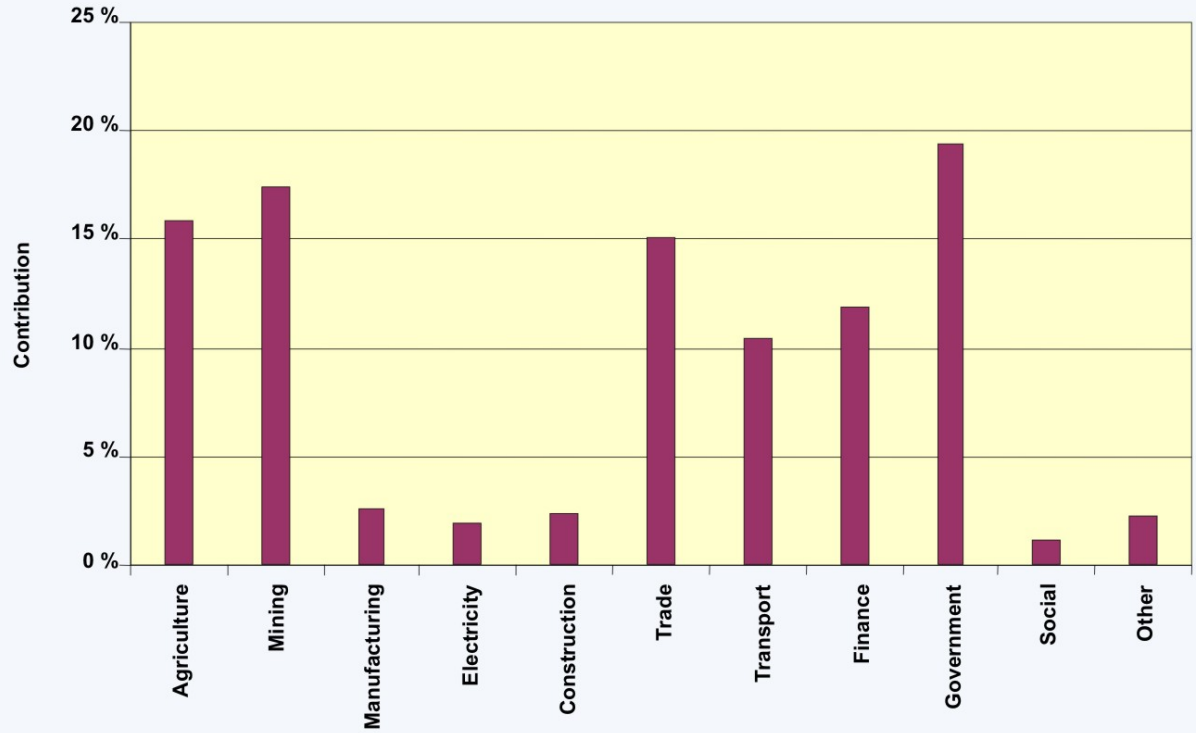
Mining activities consist mainly of the extraction of alluvial diamonds, copper, asbestos, Tiger's eye, alumni silicate, limestone, dolomite, and other minerals and metals. The mining of alluvial diamonds, which occur mainly along the coast is still very important. Copper is mined in the Okiep Copper District, which includes Springbok and Nababeep, as well as at Aggenys.

The main comparative advantages with respect to future economic growth in the water management area, relate to mining and agriculture as the primary production sectors. Attributable to the large variety of minerals and metals found in the region, the mining sector in the Lower Orange water management area is relatively more competitive than the remainder of South Africa. Most of the deposits are already being mined and although no large new developments are anticipated, there are also no indications of a serious decline in activity. The sector can therefore be regarded as relatively stable over the medium term, but may decline over the longer term.

The importance of the agricultural sector is attributable to the climate, which is particularly suitable for the growing of high value crops, especially table grapes, together with the availability of water along the Orange River. This is further enhanced by an airport at Upington for export

purposes, as well as good road connections to local markets. Thanks to the climate, a window of opportunity exists for the provision of high quality table grapes to Europe early in the season when prices are at their highest. Other products include dates, raisins, wine, flowers, vegetables, grain and fodder crops.

Expansion of the agriculture sector is limited by the availability of water for irrigation and in some instances by arable land. To stimulate growth in agriculture will therefore require improved water use efficiency as well as further conversion to higher value products. The agricultural sector is also vulnerable to changes in the market and competition from other countries (**DWAF, 2003b**).



LOWER ORANGE WMA **Sectoral contribution to the economy** **Fig 5**

Of the work force of 122 000 persons in the water management area in 1994, 56% were active in the formal economy and 32% unemployed (which is higher than the national average of 29%). The remaining 12% were active in the informal economy. Of those formally employed, 30% were in the government sector, 30% in agriculture and 12% in trade (**DWAF, 2003b**).

2.2.4 Demographics

The Lower Orange water management area covers the most sparsely populated part of South Africa and although being the water management area with the largest geographic area, it has the second lowest population (382 200) of all water management areas. Over 70% of the population are classified as urban, living in regional and mining towns throughout the water management area. In the Orange Mainstream sub-area, where farming communities are concentrated along the river, the rural proportion of the population is slightly higher at about 40%.

In the more remote and sparsely populated parts of the water management area, less than 20% of the population is regarded as rural, with most of the people living in mining and regional towns.

Attributable to the lack of strong economic stimulants in the region, the general trend in the country of young people migrating to the larger urban centres together with the impacts of HIV/AIDS, a general decline in population is expected throughout the water management area. This is likely to apply to both the urban and rural components of the population. (**DWAF, 2003b**).

2.2.5 International

The Lower Orange WMA is part of the Orange River Basin, with South Africa, Lesotho, Botswana and Namibia as co-basin countries. Co-operation amongst the Orange River Basin countries is facilitated through the Orange-Senqu River Commission (ORASECOM), with membership by the basin countries (See Orange River System Overarching ISP; **DWAF, 2004a**).

2.2.6 Sub-areas

The WMA shows significant spatial variations in climate, water availability, level and nature of economic development and growth, and it is therefore divided into sub-areas for more detailed consideration. This results in improved representation of the water resource situation and better use of information for strategic management purposes.

Delineation of the sub-areas was based on practical considerations such as size and location of sub-catchments, homogeneity of natural characteristics, location of pertinent water infrastructure (e.g. dams), and economic development. These sub-areas have no administrative weighting and the catchment management agency may choose to introduce smaller or alternative subdivisions.

Three sub-areas have been used to facilitate the presentation and management of key issues in the water management area. These sub-areas as shown on **Figure C-1 of Appendix C**, are :

- The Orange sub-area, which includes the Orange River over the whole of its length through the water management area, together with minor tributary streams.
- The Orange Tributaries sub-area, comprising the catchments of the Ongers and Hartebeest Rivers.
- The Orange Coastal sub-area, which includes the mostly dry water courses which lead directly to the ocean. (DWAF, 2003b)

Some of the sub-areas have been further sub-divided into sub-catchments. The hydrological sub-catchments showing numbered quaternary sub-catchments, hydrological sub-catchment boundaries, rivers, dams and main towns are shown in **Figure C-2** in **Appendix C**.

2.3 Resource availability

2.3.1 Surface Water

Ninety percent of the runoff generated in the two Orange River WMAs is generated in the Upper Orange WMA. The bulk of the runoff generated in the Lower Orange comes from the Fish River

in Namibia (approximately 60% of the Lower Orange runoff) but this only enters the main Orange River close to the river mouth. The bulk of the surface water in the Lower Orange Water Management Area is therefore found in the main stem of the Orange River, with virtually all the surface water flowing into the Orange River from the Upper Orange and Lower Vaal WMAs.

The two major storage dams, Gariep and Vanderkloof, which are both used to supply all the irrigation, urban, mining and environmental requirements along the Lower Orange River, are located in the Upper Orange WMA, but both are of vital importance to the Lower Orange. There are no large storage dams in the WMA, with only a few smaller dams on some of the main tributaries. These include:

- Smartt Syndicate Dam (101 million m³ gross storage) on the Ongers River.
- Van Wyksvlei (143 million m³ storage) on the Carnarvonleegte.

There are also several diversion weirs in the Orange River of which Boegoeberg (20 million m³ storage) is the largest.

Reliable estimates of the surface water resources in the Upper Orange and Vaal River catchment are therefore of extreme importance for the Lower Orange. There is a fairly high confidence in the yield estimates of the surface water in the main system although some of the hydrology is relatively old. The hydrology for the Lower Orange is however not at an acceptable level for the planning or operation of any local water supply schemes outside the Orange River (see **Table A.1.1** in **Appendix A** for detail on the available hydrology). For more detail the reader is also referred to the Upper Orange ISP (**DWAF, 2004b**) and Orange River Overarching ISP (**DWAF, 2004a**) documents.

The total water available for use in the Lower Orange water management area at the year 2000 development levels summarised in **Table 2.1**.

Table 2.1: Available water in year 2000 (million m³/a)

Sub-area	Natural resource		Usable return flow			Total local yield (1)	Transfers in	Grand Total
	Surface water	Ground-water	Irrigation	Urban	Mining and bulk			
Orange	(1 092)	9	96	1	0	**(986)**	2 083	**1 097**
Orange Tributaries	9	13	0	0	0	**22**	0	**22**
Orange Coastal	0	3	0	0	0	**3**	6	**9**
Total	**(1 083)**	**25**	**96**	**1**	**0**	**(961)**	**2 083**	**1 122**

The negative yield for the Orange River within the Lower Orange water management area, as shown in **Table 2.1**, is as a result of evaporation losses and evapotranspiration by riparian vegetation along this reach of the river, which by far exceed the run-of-river yield contributed by local inflows. It also includes a component for losses associated with insufficient management of releases from Vanderkloof Dam.

Potential for a dam in the Lower Orange River has been identified for the re-regulation of releases from Vanderkloof Dam as well as the storage of flood flows mainly from the Upper

Orange and Vaal Rivers and to a lesser extent also from the flows generated in the Lower Orange. This would contribute to the improved management of the Orange/Vaal River System, and facilitate more water being made available for use.

No meaningful potential for surface water regulation exists in the Orange Coastal sub-area.

Factors that could have a significant impact on the available surface water resources include:

- Saving in operational losses with regards to releases from Vanderkloof Dam (See Orange River Overarching ISP; **DWAF, 2004a**).
- Implementation of the Reserve on the Orange River (See Orange River Overarching ISP; **DWAF, 2004a**). Indications are that the reserve can vary significantly from the current environmental flows released from Vanderkloof and will therefore significantly impact on the current surplus available in the system.
- Utilising inflows from the Vaal River.
- Irrigation Return Flows. Very little data is available but return flows commonly amount to 10% of irrigation water.

Yield analysis assessments for local surface water resources beyond the Orange River main stem can, with the current available hydrology, only be undertaken on a cursory level (using WR90 data). This should be carried out only when the need exists and will be the responsibility of the specific towns or towns in need.

2.3.2 Groundwater

Summarised information on groundwater is given in this section. For detail information the reader is referred to **Appendix B** of this report.

Groundwater utilisation is of major importance across wide areas in the Lower Orange WMA and often constitutes the only source of water. It is mainly used for rural domestic supplies, stock watering and water supplies to towns off the main stem of the Orange. These resources must be properly managed and developed. As a result of the low rainfall, recharge of groundwater is limited and only small quantities can be abstracted on a sustainable basis. Artificial recharge of groundwater is practised in some areas where water from small dams is transferred through pipelines into boreholes located in the area of recharge of the main production boreholes. Aquifer characteristics (borehole yields and storage of groundwater) are also typically unfavourable because of the hard geological formation underlying most of the water management area.

In the Orange Tributaries sub-area 60% to 70% of the available water is supplied from groundwater sources. Groundwater also constitutes an important source of water for rural water supplies in the Orange River, although only a small proportion of the total available water. Much of the groundwater abstracted near the river (Orange sub-area), is actually recharged from the river and could also be accounted for as surface water. Groundwater availability in the coastal region is extremely limited as a result of the lack of rainfall. Close to the sea there is a strong risk of seawater intrusion into coastal aquifers.

The interaction between the mining activity and groundwater is managed through the EMPR and the water use licensing process. Some impacts do exist with regard to localized dewatering of aquifers. These impacts are however localized and very little data exist in this regard. The information from the compliance monitoring systems at the mines needs to be integrated into the DWAF monitoring systems and regularly reviewed. Mines utilise the groundwater available but are still largely dependant on surface water, which is in most cases supplied from the Orange River.

Boreholes and abstraction from boreholes are seldom managed properly and therefore the failure of boreholes is experienced. Borehole siting needs to be based on proper geo-technical work to limit the drilling of unsuccessful boreholes. As result of this some towns have drilled many boreholes without much success. From the list of towns and related water resources given in **Appendix D** it is evident that shortages in the supply from groundwater are experienced at Vanwyksvlei, Strydenburg, Carnarvon and Garies.

Proper management and monitoring of groundwater sources by municipalities and other users are of vital importance. There is a need to provide groundwater information and to create an improved understanding of groundwater at a local level. Municipalities should also investigate groundwater potential outside town boundaries as a possible source.

Groundwater monitoring and data on the availability of groundwater in general is insufficient. (More detail on groundwater is included in **Appendix B** of this report) Water quality is a limiting factor to groundwater use and is discussed in **Section 2.3.3**.

2.3.3 Water Quality

In its historical natural state the quality of water in the Orange River was good, although of high turbidity during flood flows. Water from the tributary streams tends to be of high salinity. Both the flow regime and water quality in the Orange River has, however, been severely impacted upon by extensive upstream developments. Salinity in the Orange River has increased due to the transfer of high quality water out of the Orange River (in Lesotho and the Upper Orange WMA) and as a result of high salinity irrigation return flows along the Orange River. Poor quality water from the Vaal River, which contains a high proportion of irrigation return flows as well as treated urban effluent, also enters the Orange River. Salinity is at present still moderate and acceptable along the main stem of the Orange River. Deterioration can be expected with increased upstream irrigation and the situation must be closely monitored.

There are algal blooms experienced in the main stem due largely to irrigation return flows, diffuse sources and poor quality water from the upstream Vaal WMAs. The algal blooms are of particular concern as they are potentially toxic. An algal monitoring programme along the Orange River as well as management and communication protocols have been developed by DWAF if the algal blooms are identified as toxic. Studies and monitoring programmes are underway to understand the current algae behaviour.

Groundwater quality varies from good to unacceptable in terms of potable standards. The groundwater quality is one of the main factors affecting the development of available groundwater resources. Although there are numerous problems associated with water quality,

some of which are easily corrected, total dissolved solids (TDS), nitrates (NO^3 as N) and fluorides (F) represent the majority of serious water quality problems that occur.

The approach to the management of water quality in this and the upstream WMAs, is to develop water quality management plans specifying Water Quality Objectives (WQO). In the Orange and Vaal River Systems the WQO will have to be developed with full cognisance of downstream impacts, to cater for the interdependence of the WMAs. A fully integrated water quality management plan would therefore be the only way to derive appropriate WQO in each WMA and to specify the minimum WMA cross-boundary water quality objectives (See Orange River Overarching Report, (DWAF2004a)).

Water quality issues that need to be addressed include diffuse pollution sources from agriculture, management of local sanitation problems at small towns, and the algae problem on the Orange River main stem.

2.3.4 The Reserve

The instream and estuarine flow requirements were determined in 1996 for the Orange River downstream of Vanderkloof Dam in the ORRS (more or less at intermediate level but methodology differ from that currently used and accepted). The ORRS estimated the river mouth requirement as approximately 290 million m^3/a and the in-stream flow requirement for the river to be 270 million m^3/a. River evaporation requirements along the Orange River are extremely high and amount to a total of 615 million m^3/a at current operating conditions.

The environmental and river evaporation requirements are all met by releases from Vanderkloof Dam. There is however, no accurate gauging of the flow reaching the Orange River Mouth, which makes it extremely difficult to manage these environmental flow requirements. The gauging station at Sendelingsdrift, which is currently in the planning phase, is ideally located for this purpose. High priority should be given to the construction and implementation of this gauging structure.

At present the environmental flow requirements set in the ORRS are being maintained. However the winter flows at the mouth are too high and prevent the closure of the mouth during the winter months. This is not due to the flow pattern set, but due to the hydropower releases made by Eskom during winter. However, Eskom will only be allowed to generate the winter hydropower when there is surplus water available in the system. The surplus is expected to disappear over the next 5 years when irrigation is taking up the last allocated water. This problem should however be discussed with Eskom, as it might be possible for Eskom to have no winter releases for at least one of the winter months, allowing the river mouth to close.

Although the current methodology used to determine the ecological requirements has significantly improved since the ORRS (1996), a fair amount of effort and time was spent during the ORRS to determine the environmental requirements for the Orange River main stem.

Modified Desktop level estimations of the environmental requirements as part of the current Lower Orange Management Study (LORMS) study, are showing significantly higher requirements for the environment than those obtained from the ORRS, and it is therefore possible that the comprehensive Reserve might have a significant impact on the available water

resources. (See Orange River Overarching ISP (**DWAF, 2004a**)). This implies that a comprehensive Reserve determination will have to be done in future to obtain a more reliable estimation of the environmental requirement.

The preliminary determination from the ORRS will be used for the main stem of the Orange River until better estimates have been determined for the Orange River and the main tributaries. The Orange River Reserve will have to be determined in close co-operation with the Vaal River Reserve Determination (See Orange River System Overarching ISP (**DWAF, 2004a**)).

It is important to have a proper ecological monitoring system for the Orange River in place as soon as possible, and to improve the low flow gauging in the river specifically close to the river mouth.

2.4 Water Requirements

2.4.1 Current Requirements

Reliable water requirement data (current and future projections) is essential for water resource operational and development planning activities. Irrigation is by far the dominant water use sector in the Lower Orange water management area, representing 94% of the total requirement for water. Water requirements for urban, rural and mining use respectively represent 3%, 2% and 1% of the total water requirement in the WMA.

Virtually all of the irrigation developments situated along the main stem of the Orange River, are dependent on water abstractions from the river. With most of the irrigation being for high value orchard type crops, much of the water is required at a relatively high assurance of supply.

Limited irrigation is also practised along some of the main tributaries (Orange Tributaries sub-area). Irrigation in this region is generally opportunistic and at a very low assurance of supply, with most of the area only planted in years of high runoff when sufficient water is available.

Some of the water abstracted for irrigation from the Orange River drains back to the river as return flows, for potential use downstream (or as part of the freshwater requirements for the estuary). These return flows are estimated to be in the order of 96 million m^3/a and are included in the water balance calculations as well as in the releases made from Vanderkloof and Gariep dams.

Most of the urban and mining requirements for water in the WMA are also in the Orange Mainstream sub-area. In addition, water is transferred from the Orange River for urban and mining use to the Orange Coastal sub-area (see **Figure C2** in **Appendix C**).

Water requirements in the Orange Coastal sub-area are very small and are mainly associated with towns such as Springbok, Steinkopf and Port Nolloth as well as the mines in the area.

A proportion of the water used in urban areas is also used non-consumptively and again becomes available as effluent. At the larger centres in close proximity of the river, most or all of the effluent is discharged back to the river after treatment. Effluent from smaller towns typically evaporates from maturation ponds, or may be absorbed by irrigation and infiltration (**DWAF, 2003b**). A summary of the year 2000 Water Requirements at a 98% assurance (1 in 50 year) level is given in **Table 2.2**. The data in **Table 2.2** were obtained from the Lower Orange WMA

Overview Report (**DWAF, 2003b**). The irrigation in the Orange sub-area has however been increased by 48 million m³/a due to changes in the WMA border. This resulted in the inclusion of the irrigation in the Douglas area that was previously part of the Lower Vaal WMA. The effect of the 4 000 ha earmarked for resource poor farmers on the water requirements is also included in **Table 2.2**.

Table 2.2: Year 2000 base scenario water requirements (million m³/a)

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Total local require-ments	Transfers out (3)	Grand Total
Orange	1 009	12	9	7	**1 037**	60	**1 097**
Orange Tributaries	16	8	7	0	**31**	0	**31**
Orange Coastal	0	5	1	2	**8**	0	**8**
Total	**1 025**	**25**	**17**	**9**	**1 076**	**54**	**1 130**
Total with 4 000ha included	**1 072**	**25**	**17**	**9**	**1 123**	**54**	**1 177**

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) Although 60 million m³/a is transferred out of the Orange Sub-area, only 54 million m³/a is transferred out of the WMA to Namibia with the remaining 6 million m³/a transferred internally to the Orange Coastal sub-area.

The process of the verification of existing lawful use is currently being carried out and need to be completed. From this process illegal users were identified and test cases to curb illegal irrigation water use are currently underway. Success has already been achieved in the Ongers sub-catchment area. This needs to be a continuous process to minimize the illegal use of water.

There is a need to obtain better information on actual irrigation water use, as this is by far the largest consumer of water and very little measured water use information is available. With regards to urban water use it is necessary that municipalities should check their water demand projections on an annual basis with a full update on a 5-year basis to co-inside with a National Census. It is further important that DWAF should interact with the process of approval of WSDPs, to ensure that meaningful data are obtained and to communicate back to the municipalities with regards to the larger water balance.

The Lower Orange WMA is part of the total Orange River System and planning and operations must be considered as part of the whole system. The water requirements of the larger system are described in the Orange Overarching ISP document (**DWAF, 2004a**).

2.4.2 Future Water Requirements

As part of the NWRS, estimates of possible future water requirements were made based on scenarios for population and economic growth, for the period until 2025. In addition provision was made for known and probable future developments with respect to power generation, irrigation, mining and bulk users. The quantification of the projected future requirements for water includes the development of an additional 4 000 ha of irrigation as was approved in principle by the Minister for purposes of poverty relief and the settlement of emerging farmers in the Lower Orange WMA. The total requirements for the year 2000 was 1 130 million m³/a and

will increase to approximately 1 177 million m³/a when the impact of the 4 000ha is included. Little change is foreseen with respect to the future urban and rural water requirements, as can be seen from **Table 2.3** for the year 2025 base scenario water requirements. The base scenario total projected demand for the year 2025 is 1 174 million m³/a and includes the 4 000ha for resource poor farmers and shows a slight decrease in the urban and rural requirement. The high scenario projection for the year 2025 raises this to of 1 197 million m³/a. **(Table 2.3** is from Overview report Lower Orange (**DWAF, 2003b**). The irrigation in the Orange sub-area has however been increased by 48 million m³/a due to changes in the WMA border.)

Table 2.3: Year 2025 base scenario water requirements (million m³/a)

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Affore-station (4)	Transfers out	Total require-ments
Orange	1 056	11	9	7	0	0	60	**1 143**
Orange Tributaries	16	7	6	0	0	0	0	**29**
Orange Coastal	0	5	1	2	0	0	0	**8**
Total	**1 072**	**23**	**16**	**9**	**0**	**0**	54	**1 174**

Notes: (1), (2) & (4) as for Table 2.2

Water requirement projections for planning purposes should include scenarios with different levels of growth and the likely impact of WCDM.

2.4.3 Poverty eradication and its effect on water requirements

Poverty eradication is one of the central themes of government policy. The Department is therefore taking up opportunities to implement or support poverty eradication initiatives. These new initiatives and projects are of extreme importance and care must be taken to ensure that water allocated for this purpose are used effectively and are positive to the welfare of this country.

One of the main poverty eradication actions in the Lower Orange WMA that has a direct impact on the total water requirement is the 4 000 ha earmarked for resource poor farmers. Water for this purpose is to be supplied by releases from Vanderkloof Dam. A total of 12 000 ha was earmarked for resource poor farmers to be supplied from Gariep and Vanderkloof dams of which 4 000 ha are for development in the Lower Orange WMA. For more detail with regards to the full 12 000 ha, the reader is referred to the Upper Orange ISP (**DWAF, 2004b**) and the Orange River System Overarching ISP (**DWAF, 2004a**).

The aim of these allocations is for poverty relief and rural development. Very few of these developments have been implemented, although some are in progress. Potential irrigation areas were identified in the ORRS for possible future development, and in the LORMS investigations for potential irrigation areas and crops are focussed on the area along the RSA-Namibian border. Additional areas for potential future irrigation along the common border have been identified from the LORMS. The final allocation of new irrigation areas should take place through the Co-ordinating Committee for Agriculture and Water (CCAW) to ensure that

developments are viable and sustainable. (The Irrigation Action Committees (IACs) are in the process to be transformed into the CCAWs (See **Section 2.7.4** for detail).)

Other initiatives also include the poverty eradication budget of Working for Water, funds from the Premier's Office to eradicate the bucket system as part of sanitation and the health and hygiene awareness campaigns. DWAF should continue to be involved in poverty eradication initiatives and be on the lookout for new opportunities.

2.4.4 Transfers

There is currently a release obligation (or transfer as referred to in the NWRS) from the Upper Orange WMA by means of releases from Vanderkloof Dam. These releases are the main source of water for the Lower Orange and users along the Orange River is totally dependent on these releases. This release amounts to ±2 123 million m³/a when the 4 000ha for resource poor farmers is included and does not include the effect of spills from Vanderkloof Dam. These releases are sufficient to supply al the users along the Orange River main stem as well as the environmental and river evaporation requirements. The environmental and river evaporation requirements are both natural requirements and are therefore not included in the total requirement of 1 177 million m³/a as indicated for the year 2000 (4 000 ha additional irrigation included) in **Table 2.2**. There is no release obligation from the Vaal to the Lower Orange and it is only spills from the Vaal that enters the Orange River.

Water used along the common border by Namibia is referred to in the NWRS as transfer water. This includes all the abstractions by Namibia for irrigation, urban and mining purposes and amounted to approximately 54 million m³/a in the year 2000. This is the only transfer out of the WMA.

The RSA and Namibia is currently in the process to reach an agreement on the water use along the common border. This issue is addressed in more detail in the Orange River Overarching ISP document. As part of the national level agreements, bodies will be created to decide on cross border issues. At local level it is important that the WMA should have representation on the body to be able to address practical issues.

Other existing transfers within the Lower Orange WMA include the following:

- Water abstracted at Henkriesmond in the Orange River by the Springbok Regional Water Supply Scheme. Water is transferred from there to the towns Springbok, Steinkopf, Nababeep, Okiep and Kleinzee located in the Coastal sub-area.
- Water abstracted at Alexander Bay at the Orange River Mouth and transferred to Port Nolloth further south along the coast.
- The Kalahari West Rural Water Supply Scheme transferring water from the Orange River at Upington to the north.
- The Pelladrift scheme taking water from the Orange River to Pofadder, Aggeneys Pella, Black Mountain Mine and some farmers.

2.5 Yield Balance

The Lower Orange WMA is a component of the extended Orange and Vaal River Systems, which has been the subject of various water balance and reconciliation studies in the past. Due to the inter-dependencies of the Upper and Lower Orange WMAs, it is necessary to also look at the overall water balance for the Orange River System. From the water balance given for the Lower Orange WMA (**Table 2.4**) it can be seen that 2 083 million m³/a need to be transferred from the Upper Orange WMA to the Lower Orange WMA to keep the Orange sub-area in balance. This transfer or rather release obligation from Vanderkloof Dam will increase to 2 130 million m³/a when the impact of the additional water for the 4 000ha for resource poor farmers is included.

Table 2.4: Year 2000 water balance for the Lower Orange WMA (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Local yield	Transfers in (2)	Total	Local require-ments	Transfers out (2)	Total	(1)
Orange	(986)	2 083	1 097	1 037	60	1 097	**0**
Orange Tributaries	22	0	22	31	0	31	**(9)**
Orange Coastal	3	6	9	8	0	8	**1**
Total	**(961)**	**2 083**	**1 122**	**1 076**	**54**	**1 130**	**(8)**

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

2) Although 60 million m³/a is transferred out of the Orange Sub-area, only 54 million m³/a is transferred out of the WMA to Namibia with the remaining 6 million m³/a transferred internally to the Orange Coastal sub-area.

(**Table 2.4** is obtained from the report "Lower Orange Water Management Area: Overview of Water Resources Availability and Utilisation" (**DWAF, 2003b**). The irrigation in the Orange sub-area has however been increased by 48 million m³/a due to changes in the WMA border.)

A small surplus exists with respect to the Coastal sub-area as the transfers from the Orange River are only sufficient to meet the requirements which cannot be supplied from local resources. (This surplus is less than one but rounded to one and is due to groundwater) The deficit reflected for the Orange Tributaries sub-area is attributable to the requirements for irrigation being much higher than what can reliably be supplied from the local resources, but where farming practices have been adjusted accordingly.

The required releases from Vanderkloof Dam to support the Lower Orange WMA are included as part of the total transfers out of the Vanderkloof sub-area as given for the water balance of the Upper Orange (See Upper Orange WMA ISP (**DWAF, 2004b**) and Orange River Overarching ISP (**DWAF, 2004a**) documents).

As stated in the beginning of this section, it is necessary to look at the overall water balance for the Orange River System, due to the inter-dependencies of the Upper and Lower Orange WMAs. The surplus available in the Upper Orange WMA is for use in the Upper and Lower

Orange WMAs as well as in the Fish to Tsitsikama WMA (See the Orange River Overarching ISP (**DWAF, 2004a**) for detail).

From the Upper Orange WMA water balance a surplus of 333 million m³/a was indicated for the year 2000. Most of the year 2000 surplus will however be taken up with the commissioning of Mohale Dam in 2003. Mohale Dam will result in a reduction of the surplus in the Upper Orange WMA from 333 million m³/a to 158 million m³/a. (See the Upper Orange WMA ISP (**DWAF, 2004b**) for detail).

When the effect of the 12 000 ha earmarked for resource poor farmers (4000ha Upper Orange WMA, 4000ha for Lower Orange WMA and 4000ha for Fish-Tsitsikama WMA) is included, the surplus will further reduce to only 44 million m³/a. (See the Upper Orange WMA ISP (**DWAF, 2004b**) for detail).

The water balance for the Lower Orange WMA for the year 2025 shows an increase in the support required from Vanderkloof Dam from 2 083 million m³/a to 2 125 million m³/a which is mainly as result of the development of the 4 000 ha. This balance as obtained from the Overview Report Lower Orange (**DWAF, 2003b**), is shown in **Table 2.5.** The irrigation in the Orange sub-area has however been increased by 48 million m³/a due to changes in the WMA border.

Table 2.5: Year 2025 water balance for the Lower Orange WMA (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Local yield (1)	Transfers in	Total	Local require-ments (2)	Transfers out	Total	(3)
Orange	(982)	2 125	1 143	1 083	60	1 143	**0**
Orange Tributaries	22	0	22	29	0	29	**(7)**
Orange Coastal	2	6	8	8	0	8	**0**
Total	**(958)**	**2 125**	**1 167**	**1 120**	**54**	**1 174**	**(7)**

The required year 2025 transfer from the Upper to the Lower Orange WMA is as explained before, included in the transfers out of the Vanderkloof sub-area in the Upper Orange WMA (See water balance in the Upper Orange WMA ISP (**DWAF, 2004b**) and the Orange River Overarching ISP (**DWAF, 2004a**) documents). The water balance for the Upper Orange WMA shows that there will be a deficit in the WMA of approximately 50 million m³/a by 2025. It is important to note that for the purpose of the water balances used in the NWRS all the demands and yields were converted to a 1 in 50 year assurance level. The deficit given is therefore also representative of a 1 in 50 year risk level. As the surplus available in the Upper Orange WMA is for use in the Upper and Lower Orange WMAs as well as in the Fish to Tsitsikama WMA, the same will also apply for a deficit situation (See the Orange River Overarching ISP (**DWAF, 2004a**) for detail). This deficit should however not be difficult to overcome, as it is a small volume (less than 2%) relative to the total Orange River System yield, and can be obtained by means of measures to reduce operating losses and/or WCDM (See **Section 2.6**).

Factors that can have a significant impact on the water balance are mainly of an overarching nature and are all listed in the Overarching ISP (**DWAF, 2004a**) for the Orange River System.

Indications of possible shortages in the water supply to the towns located in the WMA were given for only four (Strydenburg, Vanwyksvlei, Carnarvon, Garies) of the approximately 55 towns (See **Appendix D**). The towns, which are experiencing shortages, are dependent on groundwater and are located in the Coastal and Orange Tributaries sub-areas.

2.6 Water Reconciliation Options

From a water resource management as well as from an economic perspective, there are two very distinct parts in the water management area: the area along the Orange River with intensive irrigation developments and which is virtually totally dependent on water released from upstream water management areas; and the part remote from the Orange River which is reliant on the meagre local water resources.

Given that the water resource availability and water requirements for the Integrated Orange River System are effectively in balance, it is required to closely monitor the water balance situation on an ongoing basis. This will ensure that intervention planning can be adjusted to account for any changes that may have an impact on the projected water balance. The reader is referred to the Orange River Overarching report (**DWAF, 2004a**) for more detail with regards to the management and planning of the Integrated Orange River system.

2.6.1 Orange River main stem

For the management of the medium term surplus along the Orange River main stem it should be taken into account that currently (year 2003), almost none of the 12 000 ha earmarked for resource poor farmers (from the whole system) has yet been developed. The result is that a temporary surplus in supply is available until such time as the resource poor farmers are established. The temporary surplus can be utilised to maximize hydropower generation at Gariep and Vanderkloof Dams. The availability of the surplus should be assessed and adjusted on an annual basis as part of the annual operating analysis.

For the management of the long-term water supply along the Orange River main stem, reconciliation can be obtained by means of several options of which all are of an overarching nature and are therefore discussed in detail in the Overarching ISP (**DWAF, 2004a**). The options are briefly listed below:

- Measures to reduce the operating losses.
- Water conservation and demand management measures.
- Utilising the lower level storage in Vanderkloof Dam.
- Construction of Boskraai Dam upstream of Gariep Dam.
- Possible developments from Lesotho Lowlands Study.
- Possible options that are currently investigated in the LORMS.
    - Using the Lower Level Storage in Vanderkloof Dam.
    - Utilising spills from the Vaal River by means of real time modelling.
    - Decrease operational losses by using re-regulating dams.
    - Large Storage dam at Boegoeberg or Vioolsdrift.

- Making more water available through WCDM.

2.6.2 Areas far from the Orange River main stem

The measures of reconciling the water balance in areas removed from the Orange River should include the following:

- Implement water conservation and demand management measures as a first option to extend the supply capability of the existing water resources. Any new development should also implement sound water conservation and demand management practices.
- Investigate the utilisation of local water resources, particularly groundwater. Exploration investigations for groundwater resources should cover areas wider than the boundaries of the towns. Additional water resources could therefore be obtained to improve the water supply in areas where deficits occur.
- Working for water should focus on areas where invasive alien plants are affecting the supply and there by increasing the yield from the existing groundwater supply system.

Detailed assessments of the local water balances and reconciliation measures will be the responsibility of the Local Authorities with support (on request) by the DWAF. These assessments will only be undertaken for specific situations where there are specific water supply problems.

2.7 Infrastructure Development & Management

2.7.1 Infrastructure Development

A holistic planning effort will be required to identify the optimum bulk water storage and supply infrastructure layout that will make optimal use of the local water resources in the Upper Orange River WMA. With regards to the main Orange River System infrastructure development the reader is referred to the Orange River Overarching ISP (**DWAF, 2004a**).

Planning for the Lower Orange WMA includes re-regulating or storage dams at either Vioolsdrift or Boegoeberg to increase the water availability. Other possible infrastructure developments are small hydro- electric plants along the Orange, infrastructure to recharge groundwater and a possible supply scheme from the Lower Vaal WMA to Mier in the Kalahari. The infrastructure to recharge groundwater will be the responsibility of the Local Authorities, with the Department ensuring compliance with the NWA.

2.7.2 System Management

The management of the Orange River Overarching system is undertaken at the National Level. For a detailed description of the management of the main Orange River system, the reader is referred to the Orange River Overarching ISP (**DWAF, 2004a**).

Consideration should be given in the system operating rules to better meet the ecological flow pattern required at the Orange River Mouth and to consider releases as a means of managing the algal blooms that develop in the lower reaches of the Orange. This will receive attention in the Integrated Water Quality Management Studies of the Orange and Vaal River.

Operational losses are currently estimated at 270 million m³/a. These losses can be reduced by improved management practices but will require accurate gauging of low flows in the Orange River downstream of Vanderkloof Dam, the implementation of real time modelling and ultimately the building of a re-regulation dam at Vioolsdrift. Possible saving in operational losses of up to 170 million m³/a is estimated.

2.7.3 Monitoring and Information Systems

The CMA is responsible for the co-ordination of monitoring and information management systems to ensure that gaps do not exist, and to eliminate unnecessary duplication. The successful operation of the Lower Orange River WMA requires effective monitoring networks and information management systems. There is a 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, track water requirements and include biomonitoring to assist with the determination and implementation of the ecological Reserve. It is critical to have a coordinated monitoring programme to avoid duplications and waste of resources. The responsibility with regard to Reserve compliance monitoring needs to be determined. The Aquatic Ecosystem Biomonitoring Programme (in short River Health Programme (RHP)) cannot be used to monitor compliance as it is designed to pick up status and trends and not cause-effect relationship. However, RHP tools can be adapted and used for compliance (cause –effect relationship) monitoring.

The following weak points with regards to the monitoring and information management were identified:

1. Limited, almost no observed data available with regards to the actual irrigation water use.
2. The existing monitoring programme of the algal blooms in the lower reaches of the Orange River needs to be expanded.
3. A flow gauging weir is needed on the Orange River close to the mouth to determine operating losses and to verify the supply of river mouth ecological requirements.
4. Problems were experienced with water quality data, which resulted in difficulties with regards to the previous calibration of the salinity model.
5. The Groundwater monitoring programme need to be expanded.

As part of the Overarching ISPs, a need was identified to undertake an assessment of all the monitoring needs to support the Integrated or Overarching Water Resource Management activities in the Vaal and Orange River catchments. The most important needs are given in the situation assessment of this strategy (see **Strategy A.8**). More detail can be obtained from the recommendations given in the relevant study reports as well as inputs from the Regional Office and CMAs. Coordination is the key and responsibilities, infrastructure and catering for emerging monitoring networks in the strategy (CMS/ISP).

2.7.4 Institutional development and support

On national level, co-operative governance (i.e. liaison and integration of planning between government departments, district and local authorities) needs to be factored into the overall integrated water resources management arena, to ensure a compounded benefit to all users in the catchment. The existing Departmental and international communication systems should be used to keep track of the proposed water resource developments and land use planning as they affect water quality and erosion sedimentation. (For a description of the strategy at International level, the reader is referred to the Orange River Overarching ISP document (**DWAF, 2004a**)).

A communication process has been started in the WMA to educate, inform and build capacity with regards to the establishment of the CMA. This process will be continued with the development of forums and structures, which will form the basis for the CMA.

The Lower Orange River Remediation Forum (LORRF), which is the communication body established to assist with the management of the toxic algae blooms and microbiological problems associated with the Orange River main stem, will be continued. The communication and monitoring systems will be expanded where necessary.

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 Lower Orange WMA. Valuable documents to be used in this communication process between the parties are the WSDPs, prepared by the Municipalities as requested by DWAF, and the ISP documents prepared by DWAF.

Cabinet approved the Municipal Infrastructure Grant (MIG) on 5 March 2003. The MIG replaces current infrastructure grants that will be phased out and consolidated into the MIG. Although the Department of Provincial and Local Government (DPLG) administer the MIG, the involvement of DWAF is extremely important. The DPLG will administer the MIG subject to the oversight of the Municipal Infrastructure Task Team (MITT), which consists of nominated representatives from various Departments including DWAF. Any water related development funded by the MIG must also be reflected in the WSDPs and communicated to DWAF. The involvement and responsibilities of the DWAF with regards to the MIG should be in line with the document Principles and Methods for the implementation of the MIG" (Draft Version 1 is currently available and a copy of the document is included in **Appendix E**).

Irrigation boards are currently being transformed into Water User Associations. This process will continue and these institutions will fulfil their roles in line with the NWA, WSA and the NWRS.

The Irrigation Action Committees (IACs) are in the process to be transformed into the Coordinating Committees for Agricultural Water (CCAWs.) The CCAWs like the IACs, will provide a forum for technical planning and streamlined liaison between relevant departments, but now with a broadened focus on agriculture water use (not only irrigation) and a widened participation by relevant role-players and disciplines.

2.8 ISP Implementation Strategy

The ISP is intended to act as DWAF's perspective on how the Orange River catchment's water resources should be managed. The Implementation of the ISP is an enormous task. 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.

The ISP will be published and opened 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 Catchment Management Agencies are technically functional and Catchment Management Strategies developed.

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Appendix A: Lower Orange Water Management Area Strategies

Strategies Table of Contents

Appendix A: INTRODUCTION TO STRATEGY TABLES

The first 2 chapters of the Lower Orange WMA Internal Strategic Perspective (ISP) describe the ISP process, paint a broad perspective of the water situation in the WMA, and describe 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**. The strategy tables for each 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 ISP.

Certain issues are clearly applicable to all WMAs in the country and for these a national policy to guide the strategy needs to be developed. These issues and aspects were identified and flagged, during the development of this ISP, for consideration at **National Level**.

The table below provides a brief description of the elements contained in the strategy tables.

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 related issues and motivations to support the management actions.
Management actions (M)	The actions which need to be taken to resolve issues and tasks identified in the situation assessment.

A.1 WATER BALANCE AND WATER RESOURCE RECONCILIATION STRATEGIES

A.1.1 RESOURCE AVAILABILITY

Management objective:

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 need to be clearly defined and understood.

Situation Assessment:

Surface water resources

The Lower Orange WMA is a component of the extended Vaal and Orange River Systems. Integrated systems models have been compiled to account for the complex interdependencies that exist due to the various inter-basin transfers. The system is currently well modelled using both the WRPM and WRYM models. Model results indicated that there is currently only a small surplus available in the system (See **Strategy A.3.1**). For detail on the overarching water supply system the reader is referred to the Orange River System Overarching ISP (**DWAF, 2004a**)

The surface water resources generated within the Lower Orange alone cannot possibly supply the existing development in the WMA and a release of 2 083 million m³/a at the year 2000 from Gariep and Vanderkloof dams in the Upper Orange WMA is essential to satisfy existing demands and river requirements. The yield from the local sources as summarised in the table below is negative, as the evaporation and evapotranspiration by riparian vegetation along the Orange River, by far exceeds the run-off river yield contribution from local inflows. The water available for users in this WMA therefore amounts to 1 122 million m³/a (2 083 – 961).

Sub-area	Natural Resource		Usable return flow			Total local yield
	Surface water	Ground water	Irrigation	Urban	Mining & bulk	
Orange	(1 092)	9	96	1	0	(986)
Orange Tributaries	9	13	0	0	0	22
Orange Coastal	0	3	0	0	0	3
Total	(1 083)	25	96	1	0	(961)

Note : Values in brackets represent negative values, see description above the Table

Approximately 93% of all the surface water generated in the Orange River catchment (Vaal included) is generated upstream of the Orange/Vaal confluence. The two major storage dams Gariep and Vanderkloof, which are both used to supply all the irrigation, urban, mining and environmental requirements along the Lower Orange River are located in the Upper Orange WMA. Reliable estimates of the surface water resources in the Upper Orange and Vaal River catchment are therefore also of extreme importance for the Lower Orange and are briefly referred to in this situation assessment. For more detail the reader is also referred to the Upper Orange ISP (**DWAF, 2004b**) and Orange River Overarching ISP (**DWAF, 2004a**) documents.

There is a fairly high level of confidence in the yield estimates of the surface water in the main system, although some of the hydrology is relatively old. Hydrological data for the Fish River (Namibia) was updated as part of the LORMS and covers the period

Situation Assessment (Continued):	1920 to 2000. The hydrology for the Fish River (Namibia) represents approximately 60% of the surface runoff generated in the Lower Orange, but this only enters the Orange River ± 100km upstream of the Orange River Mouth. The runoff from the Fish River is therefore not available to most of the users along the Orange and even to users downstream of the confluence due to its sporadic nature. Although the updated hydrology for the Fish River was not done on a very detailed level, it is considered good enough to be used in the existing water resource planning and operating analysis. The remaining hydrology for the Lower Orange downstream of Vanderkloof Dam was obtained from the WR90 (WRC Study). This amounts to 40% of the runoff generated in Lower Orange WMA and represents less than 3% of the total Orange River natural runoff. These records cover the period 1920 to 1989. Although the Lower Orange hydrology was developed at a cursory level, it will not affect the yield determined for Gariep and Vanderkloof dams - the main supply source for users along the main Orange River. The water resource models, as configured for the Orange River System, are not at a high enough resolution to define the availability of local water resources in the tributaries at a sufficient level of confidence. These local resources are used to support water users that are mostly located in tributary catchments that do not have access to the main river reaches. The Ongers River is a typical example. The Lower Orange hydrology is however not at an acceptable level for the planning or operation of local water supply schemes outside the Orange River in any of the main tributaries. The reliability of the Lower Orange Hydrology is becoming more important when storage dams are considered in the Lower Orange, as currently investigated as part of the LORMS. Future studies must consider the updating and extending of the Lower Orange hydrology, or at least carry out sensitivity analyses to determine the effect of inaccuracies with regards to the existing hydrology. Although observed river flow records, rainfall records, and updated demand data are readily available for the Orange River system; it is a costly exercise to include the data into the runoff, yield and planning models. Such an exercise will typically include the following: ▪ Data records need to be verified and patched through various processes before the rainfall runoff models can be calibrated to produce natural runoff records for all the selected sub-catchments. The generated stochastic sequences must be also verified and validated before they can be used in the WRYM and WRPM. Updated environmental requirements might also be required. The WRYM can only then be updated with the new hydrology and water requirement data and used to determine the updated yield characteristics of the system. The updated short-term yield characteristics, hydrology and water requirements and projections are finally used as input to the WRPM for planning and operating purposes. ▪ Any hydrology update must be carefully planned and programmed to co-ordinate the various processes and to ensure that all the components affecting the yield figures are updated. Updates of the Lower Orange hydrology are currently not in progress or planned and an update must be considered as part of future studies. *Factors that could have significant impacts on the available surface water resources, include:* *Mainstream Orange* ▪ Most of these factors are of an overarching nature and the reader is referred to the Orange River Overarching ISP (**DWAF, 2004a**). A few additional factors are however also listed hereafter. ▪ Irrigation Return flows. Very little data is available. WCDM will reduce return flows. Water Quality will be affected. All these effects need to be included in the models.

Situation Assessment (Continued):	Existing models include return flow volumes based on assumptions. ▪ Utilising the inflows from the Vaal River. ▪ Utilising inflows from the Fish River to supply part of the River Mouth environmental requirement. This will in particular be beneficial if a dam is in place in the Lower Orange, as environmental releases from the dam can be decreased or stopped in time to be able to utilise flows from the Fish River for this purpose. (See **Strategies A.1.3** and **A.7.1** for more detail). *Tributaries* ▪ "Saaiwalle" and small dams in some of the tributaries. These are mainly located in the southern Sak-Hartbees sub-catchment. The water is diverted into paddocks. The water use is registered and releases are required for downstream "saaiwal" users. These effects will be of local importance with insignificant impacts on the main Orange River. **Groundwater resources** Information on groundwater can be obtained from the following sources: ▪ NGDB. ▪ WARMS database. ▪ DWAF Geohydrology Northern Cape. ▪ 1:500 000 Geohydrological maps. ▪ Consultants reports and other academic reports. (See groundwater overview report in **Appendix B** for more detail) Groundwater utilisation is of major importance in the Lower Orange WMA and is the only source of water over much of the WMA. It is mainly used for rural, domestic, stock watering and supplies to inland towns. The groundwater resource is of such a nature that it cannot be used for large-scale irrigation anywhere in the WMA. Aquifer characteristics are typically unfavourable due to the hard geological formation underlying most of the WMA. Groundwater availability is site specific. The naturally poor quality and poor yields of most aquifers are a constraining factor of this resource. This is overcome in some areas by good water management practices and treatment of the groundwater. In the Orange River Tributaries sub-area about 60% to 70% of the available water is supplied from groundwater resources. Groundwater availability in the Coastal region is extremely limited as result of lack of rainfall and the risk of seawater intrusion into coastal aquifers. Long term planning for groundwater resources needs to be done through WSDPs. The current utilisation of groundwater close to the towns is approximately in balance with the sustainable yield from the source for most towns. No significant potential for further development therefore exists close to the towns, and some over-exploitation has been experienced in the coastal region. Given that no significant growth in population is expected, perhaps even a decline, this is a situation, which can be managed. Municipalities should also investigate groundwater potential outside town boundaries within a viable economic radius from the town, as a possible source and some towns already practice this. A lack of knowledge and proper understanding of the groundwater resource and resource management exists at local level.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1**. Undertake on a need basis, yield analysis assessments on a cursory level (using verified or improved WR90 data) of the local surface water resources of selected catchments supplied from local resources. This will be the responsibility of the specific Town, Irrigation Board or WUA affected, with support from DWAF from a controlling and advisory perspective. A list of all the towns located in the WMA with indications where a deficit in the water supply exist are provided in **Appendix D.**	Dir: NWRP Region Towns &IB (Priority 4)
	M2. Undertake analysis on a need basis to improve the confidence of the estimates of the unused groundwater resources. The focus should be on the towns where there are currently problems. DWAF will support from a controlling and advisory perspective. Available data should be provided and boreholes drilled in cases where there is a lack of data.	Who ever require the information (Priority 2)
	M3. Municipalities should be required to put a monitoring strategy in place to obtain sufficient data. DWAF can use licensing as a tool to encourage this. DWAF will support from a controlling and advisory perspective.	Region (Priority 1)
	M4. The hydrology update – see Orange River System Overarching ISP (**DWAF, 2004a**)	
References:	a) Orange River System Analysis Phase 1 & 2 (Report no. P D000/00/1092) b) Lower Orange WMA: Overview of Water Resources Availability and Utilisation (Report no. P WMA 14/000/00/0203). c) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697).	

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A.1.2 WATER USE REQUIREMENT STRATEGY

Management objective:	Ensure the knowledge base on the water requirement in the WMA is realistic and updated on a regular basis. Maintain and update water requirement projection scenarios for planning and management purposes.
Situation Assessment:	**Water use data** Water requirements within the water management area are dominated by irrigation water use, which represents 95% of the local requirements for water. The main urban/industrial/mining requirements for water are from Upington, De Aar, and other urban/mining abstractions along the main Orange River. Water requirements for rural domestic supplies and for stock watering are relatively small. There are no large industries with their own bulk water supplies in the water management area, while the water requirements for mining (9 million m^3/a) are also relatively small. The 60 million m^3/a transfer shown in **Table 2.2** in **Section 2.4.1** refer to the water used by Namibia along the common border (54 million m^3/a) and 6 million m^3/a transferred to the Coastal sub-area. Although the urban/industrial requirement is small, the water sources are scarce, especially in the tributaries. The irrigation areas and relevant quotas for the Main Orange River System are collated from the different DWAF offices and bulk users on an annual basis, currently captured in a spreadsheet database. This information is compared with the projected water requirements in order to make adjustments (over the short-term) for use in the annual operating analysis. It should be noted that the data on actual water use for irrigation is not available. Indications are that approximately 47% of the irrigation requirement is supplied through canal systems, and the remaining 53% directly from the rivers. The irrigation water use is calculated based on the scheduled area and quota or crop water requirements as determined by means of SAPWAT, mainly for the tributaries. In future all registered lawful irrigation use will be based on SAPWAT. There is however room for improving the available data in this regard. The process of verification of the current registered water use with that from the old permit system has been completed for the Orange River main stream and provided fairly similar results. The main differences were for some towns along the Orange River for which the permit allocations were significantly higher than their current use. The total volume of the over allocations is however very small due to the small total urban use in the system. Verification with the physical development on the ground was only done for the Middle Orange area and needs to be done for the rest of the mainstem. It is expected that the actual water use will be more than the registered water use, as 270 million m^3/a operating losses is currently experienced in the system which is partly due to over or illegal abstractions. Due to the inaccuracy of flow gauging structures in the Orange River for low flows and the fact that irrigation abstractions is not measured, it is difficult to determine what part of the operating losses is as result of over or illegal abstractions. The tributaries are currently being verified on a need basis. Some test cases to curb illegal irrigation water use are underway. Success has been achieved in the Ongers sub-catchment. Once practical experience has been gained further cases will be started with the focus on the larger illegal users. The first development of the 4 000ha earmarked for resource poor farmers is located in the Sandrift-Pella-Blocuso area (approximately 500ha) and the licensing process was started in October 2003. Other developments include 2 000ha for the Northern Cape Province referred to as the Vanderkloof Project. This is physically located in the Upper Orange WMA but within the Northern Cape Province and the allocation is

Situation Assessment (Continued):	taken out of the 4 000 ha for the Lower Orange. Although water use data for the larger demand centres is mostly available, it is necessary to plan for future updates, which will include different demand projection scenarios such as with and without various levels of water demand management and conservation. **Table 2.2** in **Section 2.4.1** gives a breakdown of the water requirements between the indicated sectors and components for the year 2000. The total water use and transfers out for the Lower Orange River System for the year 2000 was estimated at 1 130 million m^3/a and increase to 1 177 when the 4 000ha earmarked for resource poor farmers in the WMA (Or Northern Cape Province) is included. Over and above the requirement of 1 177 million m^3/a**,** 615 million m^3/a is released from Vanderkloof to supply river requirements (mainly evaporation from river of which 559 million m^3/a occur within this WMA) as well as 289 million m^3/a for the river mouth environmental requirements and 270 million m^3/a to cover the operational losses. Between the year 2000 and October 2003, 1 936 ha of water allocations, comprising a total volume of 19.7 million m^3/a, has been transferred, as part of trading agreements between irrigators, from the Eastern Cape (Orange Fish tunnel supply area) back to the main Orange River. The traded volumes are now mainly utilised in the Lower Orange WMA. **Table 2.3** in **Section 2.4.2** gives a breakdown of the water requirements between the indicated sectors and components for the year 2025. The estimated total water use by 2025 for the Lower Orange River System is 1 174 million m^3/a. This includes the effect of the 4 000 ha earmarked for resource poor farmers. This is slightly lower than the year 2000 requirement (plus 4 000 ha requirement) of 1 177 million m^3/a and is as result of the slight reduction in the urban and rural requirement. The 2025 water requirement as given in **Table 2.3** excludes the water allocation of 19.7 million m^3/a that has been transferred from the Eastern Cape back to the main Orange River, as this is information that only recently become available. In the water balance it is currently still included in the transfer volume from the Upper Orange WMA to the Fish to Tsitsikama WMA. **RELEVANT DATA ON A SUB-CATCHMENT BASIS** Details of the water supply to towns and the resources used are summarised in **Appendix D.** **Orange River Sub-area (Includes Boegoeberg, Neusberg, Nossob-Molopo, Vioolsdrift and Alexanderbay sub-catchments)** • The main Orange River System is used to supply almost all the water requirements in these sub-catchments, with the exception of a few small towns and some of the rural, domestic and stock water requirements. • Towns located in these sub-catchments areas include: *Boegoeberg sub-catchment*, Griekwastad, Niekerkshoop, Marydale, Prieska and Westerberg. Prieska and Westerberg are supplied from the Orange River. Groundwater is the main source of water for the remaining towns. *Neusberg sub-catchment,* Groblershoop, Upington, Keimoes and Kakamas. All the towns are supplied from the Orange River. *Vioolsdrift sub-catchment,* Augrabies, Marchand, Pofadder, Aggeneys and Onseepkans. All the towns are supplied from the Main Orange River. *Alexander Bay sub-catchment,* Concordia, Vioolsdrift and Alexander Bay. All the

Situation Assessment (Continued):	towns are supplied from the Orange River. The base scenario shows a small decline in the water requirements from these towns until 2025, and the high growth allows for an increase of approximately 60% of the 2000 demand to the year 2025. The base scenario projection is considered as the most probable projection and is currently used by DWAF for planning purposes. • Irrigation is the main water user in these sub-catchments and includes: (see map in **Appendix C**) *Boegoeberg sub-catchment*, ±24 000ha irrigation (± 240 million m³/a) from the Orange River Main stream and Douglas Weir in the Vaal River. Douglas Weir is however also supported with water from the Orange River through a canal from Marksdrift. This area includes the Lower Vaal and Middle Orange irrigation areas. *Neusberg sub-catchment,* ±25 370ha irrigation (± 380 million m³/a) from the Orange River Main stream. About 80% of the irrigation abstractions in this sub-catchment are through canal systems and diversion weirs in the Orange River. The remaining 20% is abstracted directly from the main river. The Boegoeberg Dam, Upington and Kakamas irrigation areas are located in this sub-catchment. *Vioolsdrift sub-catchment,* ±14 320ha irrigation (± 215 million m³/a) is supplied from the Orange River main stream. About 60 % of the irrigation abstractions in this sub-catchment are through canal systems and diversion weirs in the Orange River. The remaining 40% is abstracted directly from the main river. This irrigation area is referred to as the Namaqualand Irrigation area. The irrigation on the Namibian side of the border is excluded from the irrigation area given for this sub-catchment. *Alexander Bay sub-catchment,* ±1 360ha irrigation (± 20 million m³/a) is supplied from the Orange River main stream. About 50 % of the irrigation abstractions in this sub-catchment are through canal systems and diversion weirs in the Orange River. The remaining 50% is abstracted directly from the main river. The irrigation on the Namibian side of the border is excluded from the irrigation area given for this sub-catchment. *Nossob-Molopo sub-catchment* • Very little development in this area with only two urban centres Mier and Askham, both relying heavily on groundwater. • There is no irrigation in this area. Water resources used for supply to the rural population and for livestock purposes include local groundwater as well as the Kalahari West Rural Water Supply Scheme, which obtains its water from the Orange River. Growth in the irrigation requirement is expected to be limited to the 4 000 ha allocated to resource poor farmers (already included in the water requirement table, **Table 2.2**). **Orange River Tributaries sub-area (Includes Ongers and Sak-Hartbees sub-catchments)** *Ongers Sub-catchment* • Towns located in this sub-catchment include: Strydenburg, Vosburg, Britstown, De Aar, Victoria West, Hutchinson and Richmond. These towns are mainly supplied from groundwater. • Limited irrigation development using water from the Smartt Syndicate Dam (101 million m³ gross storage) is found in this sub-catchment. The total irrigation area listed under this scheme is 1 818 ha, but due to the low assurance of supply only 16% of the total area is irrigated on average. *Sak-Hartbees sub-catchment* • Towns located in this sub-catchment include: Kenhardt, Copperton, Vanwyksvlei, Carnarvon, Loxton, Fraserburg, Sutherland, Williston and Brandvlei. These towns are mainly supplied from groundwater with some support from a few small local dams.

Situation Assessment (Continued):	▪ Limited irrigation development of ± 4 500ha (± 16 million m³/a) is found in this sub-catchment. Van Wyksvlei Dam is located in this area and is used to support 430 ha of irrigation. There is however very seldom sufficient water available (± 1 in 10 years) to irrigate the total area. Opportunistic low assurance irrigation is also commonly found in this area. Very little information is available with regards to this type of irrigation. **Coastal sub-area** ▪ Towns located in this area includes: Port Nolloth, Steinkopf, Nababeep, Okiep, Springbok, Kleinzee, Komaggas, Koiingnaas, Kamieskroon and Garies. Port Nolloth is supplied via the Alexander Bay system, and Steinkopf, Okiep, Springbok and Kleinzee from the Sprinbok system, with Orange River water. The remaining towns rely on groundwater. ▪ There is no irrigation in this area.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1**. After the completion of the verification of existing lawful use, comparisons should be made between the lawful use and the water use data applied in the water resource system models. The models must then be adjusted accordingly.	Region (Priority 1)
	M2. Initiate studies and/or processes to obtain better information on the actual water use by irrigation. This study should indicate the levels of metering that are required for specific purposes. Information such as the total area/volume supplied from groundwater, canals, major dams, directly from the river, which is measured and which not, should be provided from the study. A strategy to obtain better information on water use must be recommended from the study. The study could also be used as input to the formulation of a national guideline with regards to the measuring requirements for irrigation water use.	Region (Priority 2)
	M3. Update the water requirements and review projections of main users on an annual basis as part of the annual operational analysis.	Region (Priority 1)
	M4. Initiate processes to obtain the water requirements, projections and water resources used by smaller towns, which are not part of the large water supply schemes. The focus should be on areas where a significant increase in water use and/or shortage in supply is evident. This can typically be addressed in the WSDPs. To ensure that meaningful data are obtained, it is very important that DWAF should interact in the process and approval of the data be given by DWAF.	Local Authority/ Region (Priority 2)
	M5. DWAF must request local authorities / municipalities that the water demand projections for towns and cities be checked on an annual basis and that a full update of the projections be made on a 5-year basis, after the completion of a National Census. This information must be included in the WSDPs and should be approved by DWAF. The responsibility of these updates however lies with the municipalities. The DWAF should then check the larger water balance and communicate back to the towns/cities.	Region (Priority 1)

	M6. Further development of resource poor farmers should focus on existing unutilised irrigation areas, as there is no more surplus water available in the system. People should be motivated to initiate further development on a voluntary basis. The current unutilised water from local authorities can also be used for this purpose.	Region (Priority 2)
References:	a) National Water Resource Strategy DWAF RSA, First Edition b) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) c) Lower Orange River Management Study (LORMS) d) Orange River Water Balance – Orange River Continuous Study (Report no. P D000/00/4903)	

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A.1.3 WATER BALANCE RECONCILIATION

Management objective:	Manage the water resources to maintain a surplus or balance between the available water resources and the water requirements through progressive implementation of management measures. The aim is to schedule and implement low cost measures first, whereby the most costly measures (usually large capital intensive developments) are postponed.
Situation Assessment:	**Overall water balance situation (Integrated Orange River System)** The Lower Orange WMA is a component of the extended Orange and Vaal River Systems. This larger system has been the subject of various water balance and reconciliation studies in the past, with the purpose of quantifying the water resources availability and/or evaluating measures to transfer water from the Upper Orange to other WMAs. Detail of the overall water balance is given in the Overarching ISP (**DWAF, 2004a**). Results are, for the purpose of this ISP, summarised below. With the full Phase 1 of the LHWP in place and the 12 000ha allocated to resource poor farmers included, the surplus is about 44 million m^3 in year 2000 with an estimated shortage of 47 million m^3 in the year 2025, due to normal urban/industrial growth. It is important to note that the available surplus given is not only for use in the Lower Orange WMA but also in the Upper Orange WMA and the Fish to Tsitsikamma WMA. The growth in demand on the Orange River is relatively low and is driven by two components: ▪ Irrigation – The only planned growth in irrigation is the development of the 12 000 ha earmarked for resource poor farmers. Only limited areas have been taken up so far, and it is not known how long the full phasing of this area will take. ▪ Urban/Industrial/Mining – The growth in this demand is mainly determined by the expected increase in the Bloemwater demand (Bloemfontein, Botshabelo, Thaba 'Nchu) of 60 million m^3 and Eastern Cape (mainly Port Elizabeth) of 27 million m^3 over the projection period. This provides a total increase of 87 million m^3 for the base growth scenario and 145 million m^3 for the high growth scenario. Factors that would impact on the water balance results given above are given in the Orange River Overarching ISP. Due to the relatively small surplus now available in the system, this is reserved for high priority users. (See **Section 2.5** in the Orange River Overarching ISP (**DWAF, 2004a**)) Given that the water resource availability and water requirements for the Integrated Orange River System are effectively in balance, it is required to closely monitor the water balance situation on an ongoing basis. This will ensure that intervention planning can be adjusted to account for any changes that may have an impact on the projected water balance. **Water Balance Perspective and measures to improve water supply in the Lower Orange WMA (Orange River mainstem):** ▪ *Management of medium term surplus* At present (year 2003), limited areas of the 12 000ha earmarked for resource poor farming has been developed, with the result that there is a temporary surplus available in the system. This temporary surplus can be utilised to maximize hydropower generation over the medium term at Gariep and Vanderkloof Dams. The availability of the surplus should be assessed and adjusted on an annual basis as part of the annual operating analysis. It is expected that the surplus will reduce as the

Situation Assessment (Continued):	demands in the system grow and the allocations to resource poor farmers is utilised. It is important to note that the releases by Eskom of this surplus water would mainly be during the winter months when Eskom requires peak power generation. The normal releases for downstream users are also used to generate hydropower throughout the year. The added winter flow would however be in conflict with the ecological requirement at the river mouth that requires low flows during the winter. Arrangements with Eskom are required in this regard. ▪ The most feasible measures to reduce operating losses (primarily caused by the timing of releases over long reaches of river) should be assessed and implemented. This may include improved management and/or construction of re-regulating dams at either the Vioolsdrift or Boegoeberg sites. This aspect is being assessed as part of the LORMS. ▪ Spills from the Vaal could be utilised by means of real time modelling or a storage dam in the Lower Orange, for users in the Lower Orange and thereby reducing the support required from the Upper Orange River System. This will have an effect on the hydropower generation at Gariep and Vanderkloof Dams and therefore need to be clarified in an agreement with Eskom. Spills from the Fish River (Namibia) can be utilised in a similar manner in the future, if a storage dam is in place in the Lower Orange River. ▪ It is perceived that water conservation and demand management measures in the irrigation sector will only improve the efficiency of water use and that any savings will be taken up by the users themselves to expand their irrigated areas. It is therefore anticipated that the overall Orange River System water balance will not be significantly influenced by WCDM in the irrigation sector. Through negotiation, some of this water could perhaps be used to address inequities. ▪ WCDM should remain an important focus activity in all water use sectors as a means to reduce the cost of water supply and improve the efficiency of water use. (Further discussions on WCDM are provided in **Strategy 4**) ▪ DWAF is currently investigating the feasibility of utilising the lower level storage in Vanderkloof Dam for water supply. Previous preliminary assessments indicated that the system yield could be increased by as much as 305 million m^3/a with this option. This would reduce the reliability of the hydro-power generation capability. **RELEVANT INFORMATION ON THE SUB-CATCHMENTS:** **Table 1.1** in **Appendix D** lists all the towns located in the Lower Orange WMA, their sources of water and the current knowledge regarding the water balance. Almost no data with regards to the water supply situation for the towns not supplied from the main Orange River were available from existing reports. Information for these towns was therefore mainly obtained by means of discussions with the regional office. Detailed assessments of the local water balances and reconciliation measures will be the responsibility of the Local Authorities, supported (on request) by DWAF. **Water Balance Perspective and measures to improve water supply in the tributary catchments:** The measures of reconciling the water balance in areas removed from the main Orange River should include the following: ▪ Implement water conservation and demand management measures as a first option to extend the supply capability of the existing water resources. Any new development should also implement sound water conservation and demand management practices. ▪ Investigate the utilisation of local water resources, and particularly groundwater. Exploration investigations for groundwater and surface water resources should cover areas beyond town boundaries but within practical reach.

Situation Assessment (Continued):	▪ Undertake feasibility studies to compare all alternative options of supply on the grounds of economic, social and environmental acceptability. ▪ Working for Water should focus on areas where invasive alien plants are affecting the supply. ▪ The need has been expressed in the NWRS to develop and implement appropriate measures to manage the practice of constructing "soomwalle" and "saaidamme" for irrigation, in particular with respect to the impact it has on downstream water users.

MANAGEMENT ACTIONS			
Required actions, responsibilities and priorities:	**M1.**	Management actions to address possible measures and development options to alleviate the shortfall in 2025, the timing of intervention measures, as well as to determine the ecological requirements are included in the Orange River Overarching ISP document.	
	M2.	Different options can be followed to prevent that irrigation is using resources that might be required by towns. Towns can trade the water from irrigation users when required in future. If the town are certain that they will need the resource they should apply for a license.	Region (Priority 5)
	M3.	Develop and implement procedures for the management of "saaidamme" and "soomwalle". Particular attention should be given to the impact of this practice on downstream users. Investigations should start on a cursory level, which can be improved on over time. Any new "saaidamme" and "soomwalle" will have to go through the normal licensing procedure.	Region (Priority 2)
	M4	Water Conservation Demand Management should be promoted in all the areas supplied from the Lower Orange WMA and implemented as one of the first options to extend the supply capability of existing water resources. Indications of possible savings will be given for some of the areas in the LORMS. (Details are provided in **Strategy 4)**	Region (Priority 1)
	M5.	Implement measures to improve the water supply in the tributary catchments as required. This could include WCDM, the exploration of groundwater resources beyond the town boundaries and the removal of invasive alien plants	Local Authority/ Region (Priority 2)
	M6.	Assess the possibility of utilising the spills from the Vaal to support users in the Lower Orange. Results from the LORMS will provide more information and recommendations in this regard, which should be evaluated and implemented depending on the findings.	DIR OA (Priority 1)

References:	a) National Water Resource Strategy DWAF RSA, First Edition b) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) c) Lower Orange River Management Study (LORMS) d) Orange River Water Balance – Orange River Continuous Study (Report no. P D000/00/4903) e) Orange River System: 2002 Hydropower Operating Analysis (Report no. 8350/06)

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A.1.4 TRANSFER AND RESERVATION OF WATER

Management objective:	Reserve adequate water resources to support the transfers out of the WMA and secure internal transfers as well as the water supply to existing users within the borders of the WMA.
Situation Assessment:	**General** There are mainly three types of water transfer in this WMA. The first and most important are the major transfers into the WMA from the Upper Orange WMA. These are referred to as *transfers* in the NWRS documents as water from one WMA needs to be transferred to the other WMA to support its water users. This is not a transfer in the true meaning of the word and could be referred to as a *release obligation*. There are also transfers within the WMA to other sub-catchments, and transfers out of the WMA (See **Figure C-1** in **Appendix C**). **Existing release obligations (transfers) between the WMAs:** The release obligation is discussed in detail in the Orange River System Overarching ISP (**DWAF, 2004a**) and refers to the releases from Vanderkloof Dam to support the Lower Orange WMA. **Existing transfers within the Lower Orange WMA.** There are four transfers within the WMA as listed below: 1. Water is abstracted at Henkriesmond in the Orange River for the Springbok Regional water supply scheme. Water is transferred from there to the towns of Springbok, Steinkopf, Nababeep, Okiep and Kleinzee located in the Coastal Sub-catchment. The total volume transferred in 2000 was 4.2 million m³/a. 2. Part of the water abstracted close to the Orange River mouth for the Alexander Bay water supply system, is transferred to the Coastal Sub-catchment to support Port Nolloth. This is a relative small transfer of 0.44 million m³/a at 2000 development level. 3. Water is transferred from the Upington municipal reservoir to the area north of Upington located mainly in the Nossop-Molopo Sub-catchment. This scheme is referred to as the Kalahari West rural water supply scheme. A relative small volume of approximately 0.5 million m³/a is transferred. 4. Pelladrift scheme takes water from the Orange River to Pofadder, Aggeneys Pella, Black Mountain Mine and some farmers. The volume transferred at 2000 development level was 4.7 million m³/a. **Existing transfers out of the Lower Orange WMA.** 1. Water is abstracted along the common border area by Namibia for irrigation purposes. The total abstraction at 2000 development level was estimated at 40 million m³/a and is expected to increase to 58 million m³/a in 2005. Future growth in irrigation on the Namibian side is difficult to estimate at this stage. As part of the LORMS, Namibia indicated substantial developments in irrigation of up to 200 million m³/a in 2025. The development of these possible irrigation areas will depend on the results from the LORMS and further negotiations between Namibia and the RSA.

Situation Assessment (Continued):	2. Water is also abstracted by Namibia for urban and mining purposes. The total abstraction at 2000 development level was 12 million m³/a and is expected to increase to 16 million m³/a in 2005. Indications from the LORMS study are that these requirementswill increase to 47 million m³/a in 2025. There are uncertainties with regards to the growth in water use by Namibia. The maximum volume Namibia is allowed to abstract from the Orange River still needs to be formalised in an agreement. (See **Strategy A.1.5**)

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1**. Include recommendations of the LORMS with regards to the transfer/support from the Upper Orange WMA to the Lower Orange WMA and from the Lower Orange to Namibia.	IWRP (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition b) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) c) Orange River Water Balance – Orange River Continuous Study (Report no. P D000/00/4903)	

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A.1.5 INTERNATIONAL OBLIGATIONS

Management objective:	Comply with all International Obligations assigned to the Lower Orange WMA.
Situation Assessment:	This strategy is fully described in the Orange River Overarching ISP document (**DWAF, 2004a**). Although the agreements will take place on national level, practical issues need to be addressed on locally. As part of the national level agreements, bodies will be created to decide on cross border issues. The WMA should have representation to be able to address practical issues. Interaction between Namibia and the RSA is currently deals with several common interests including: ▪ PWC (Permanent Water Commission); with representatives from Namibia and the RSA at a national level. ▪ Orange River Mouth Interim Management Committee, including the Provincial Department of Agriculture (RSA) as well as Ministry of Environment and Tourism (Namibia). ▪ Ai-Ais / Richtersveld Trans Frontier Conservation Park (TFCP). The first draft of guidelines for the joint management of the TFCP was made available in June 2002. ▪ Lower Orange River Remediation Forum (LORRF) mainly addressing the problem of toxic algae. As part of the national level agreements, bodies will be created to decide on cross border issues. At local level it is important that the WMA should have representation on the body to be able to address practical issues.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1**. Ensure that the WMA has representation on communication and operational bodies or committees dealing with cross border issues.	Region (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition	

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A.1.6 COMPULSORY LICENSING

Management objective:	Ensure the sharing of the available water resources for both Equity and the Reserve (as priority users) and for activities to maintain the economic and social structures that rely on the water resources of the Lower Orange WMA.
Situation Assessment:	Considering the three variables (Reserve, water for equity, and a negative water balance resulting from over allocation) that could drive the need for Compulsory Licensing, the status is as follows: ▪ Currently the Reserve has not been determined for the WMA. No urgent Reserve issues were identified during the Overarching Workshops that pointed to the need for Compulsory Licensing on the basis of pressures brought upon by the Reserve. Releases are however currently made to supply the environmental requirements at the estuary based on the work done in the ORRS (See also **Strategy A.2.1**). ▪ Due to the current excess supply situation as indicated in the Reconciliation Strategy, there is no need to implement compulsory licensing on the grounds of water supply constraints. ▪ Allocations to address inequities in water allocation have already been made by means of the 4 000ha of irrigation land earmarked for emerging and resource poor farmers. These allocations must first be taken up before more will be considered. Only at that stage will compulsory licensing be considered as a possible option for re-allocation if water cannot be made available otherwise. ▪ Other measures such as WCDM, saving in operational losses etc. will be used first to deal with water supply issues in the Lower Orange WMA.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1**. Use other measures first to deal with water supply issues in the Lower Orange WMA, before using compulsory licensing. This should typically include the verification of lawfull use, eliminating of illegal users, imposing of curtailments, educating people and make them aware of the problem, improve the management of the groundwater system, etc.	Region (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition	

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A.1.7 SUPPLY TO DISTRICT AND LOCAL MUNICIPALITIES

Management objective:	Ensure that local and other authorities implement measures for efficient utilisation of the available resources and have sufficient water resources to supply their requirements. The objective with water supply to local authorities should be to implement economical feasible supply options with acceptable environmental impacts.
Situation Assessment:	A significant number of towns in the WMA are supplied directly from the Orange River. A number of supply schemes have been implemented to transfer water from the Orange River some distance into the arid areas to support the water requirements of urban developments that are mostly associated with mining activities in the WMA (see **Strategy A.1.5**). The water requirements in the above-described situations are considered as part of the water balance of the Integrated Orange River System. However, a third supply situation exists where towns rely partially or fully on local water resources. In order to obtain an indication of the supply situation in these cases, information was obtained from the Regional Office. The results of the balance calculations are presented in **Appendix D.** There is a fair amount of groundwater resources in the WMA, with some already utilised, and in some cases even over-utilised. DWAF estimated the total abstraction from groundwater at 10 million m³/a for domestic supply to approximately 100 000 people. Groundwater is an extremely valuable source of supply and is in many cases the only option available to towns. Most of the problems with groundwater are due to the fact that it is not managed correctly and it is therefore critical that this be well managed within the limits of the resource. This places strong limits on the demand and requires careful monitoring, scientific operation and strict operating rules. In areas distant from the Orange River, groundwater should be assessed as one of the first options when considering further development of the water supply to Local Authorities and will in many cases be the most economic option. The NWA now allows a town to search for groundwater outside its boundaries. In a number of places boreholes were drilled, but no funds were available to equip the boreholes. Some of the desalination plants in the coastal areas need replacing. These and other related problems should be routed through the WSDPs. It is DWAFs role to assist people to route the problems through the correct channels. The following towns were indicated to experience a shortage in water supply, Strydenburg, Vanwyksvlei, Carnarvon, and Garies. Carnarvon and Vanwyksvlei have problems with invasive alien plants within their supply catchments. Clearing these would improve the groundwater supply in the area. The impact of sanitation on water resources does not seem to be a major problem in this WMA. A large number of people has opted the route of dry sanitation, mainly for the reasons of affordability and availability of sufficient water. Water Conservation and Demand Management should be regarded as the first possible measure to be utilized before the development of any future resource is considered. New users will also have to develop and implement plans to ensure efficient use of water.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1**. Promote the implementation of WCDM measures as first priority before developing alternative water resources.	Region (Priority 1)
	M2. Promote and encourage the utilisation of groundwater resources for local water resource development and in particular for Vanwyksvlei, Strydenburg, Carnarvon & Garies. Clear invasive alien plants in areas where they significantly affect the water supply. Water Service Development Plans and feasibility studies (business plans) should indicate what groundwater supply options were considered for development.	Region (Priority 1)
	M3. Pro-actively assess local groundwater yield and quality capabilities as a support function to local authorities that require additional water resources.	Region (Priority 1)
	M4. Provide support to local authorities in the assessment of water resource availability and water quality for areas where extensions to the water resources are required. The need for this information should be identified in the WSDP development process and the results should be included in the WSDP reports.	Region (Priority 1)
	M5. Provide and support groundwater utilization and management protocols for all the required groundwater actions..	Region (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition b) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) c) Lower Orange River Management Study (LORMS) d) Orange River Water Balance – Orange River Continuous Study (Report no. P D000/00/4903)	

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A.2 WATER RESOURCES PROTECTION STRATEGY

A.2.1 RESERVE AND RESOURCE QUALITY OBJECTIVES

Management objective:	The main stem of the Orange River and all major tributaries 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 Orange River catchment, with the Reserve being implemented and enforced. The Reserve determination for the Lower Orange WMA will be co-ordinated with the Reserve determination for the Upper Orange WMA and the Vaal River System.
Situation Assessment:	Ecological water requirements have been determined in the ORRS and in the more recent LORMS. As part of the ORRS, the river and river mouth environmental requirements were determined. From the ORRS it was estimated that the river mouth requires approximately 290 million m^3/a and the instream flow requirement for the river was estimated to be 270 million m^3/a. At the same time a separate study by the WRC, determined river requirements downstream of Vanderkloof Dam as result of evaporation from the surface of the river, evapo-transpiration from riparian vegetation and seepage. These river requirements were estimated at 615 million m^3/a for the river at normal operating conditions. The river requirement is a natural phenomenon and is regarded as part of the environmental requirement. All these requirements are currently released from Vanderkloof Dam. The Orange River estuary has been declared a transborder Ramsar wetland and there are plans to expand the boundaries of the site. A draft management plan for the Orange River mouth has been produced. Recommendations in the plan include monitoring at the mouth to determine the flows entering the estuary by establishing a gauging station. This flow gauging station will also assist with the estimation of operational losses. A gauging station at Sendelingsdrift is currently in the planning phase and will be ideal for the monitoring of flows entering the estuary. One of the main problems with the flow currently reaching the Orange River mouth is the high flow in the winter months, which prevents mouth closure. This is mainly as a result of surplus releases to generate additional hydropower. Eskom is only allowed to generate the additional hydropower when there is a surplus available in the system. With the expected increase in demands this surplus will disappear in the next 3 to 5 years and the additional winter releases are likely to cease. This problem should however be discussed with Eskom, as it might be possible for Eskom to have no winter releases for at least one of the winter months, allowing the river mouth to close. Although the current methodology used to determine the ecological requirements has significantly improved since the ORRS (1996) a fair amount of effort and time was spent during the ORRS to determine the environmental requirements for the Orange River main stem. As part of the LORMS study, an adjusted desktop estimate of the ecological Reserve has been undertaken. When the effect of this Reserve on the system yield was determined, a reduction in the system yield of approximately 100 million m^3/a was evident compared to the scenario where the ORRS ecological requirements were used in the model. This implies that a comprehensive Reserve determination will have to be done in future to obtain a more reliable estimation of the environmental

Situation Assessment (Continued):	requirement. There is no need to immediately revise the ecological water requirements. However the ecological Reserve will have to be determined. The methodology to be used to set the Reserve and the timing of the determination must be decided. In the mean time, the approach to be adopted will be to continue operating the system using the ORRS ecological water requirements but institute an ecological monitoring programme to collect data to understand the behaviour of the system. Consideration will also be given to adjusting the releases to improve the flow patterns.

MANAGEMENT ACTIONS			
Required actions, responsibilities and priorities:	**M1**	Provide the required infrastructure to obtain accurate flow measurement upstream of the river mouth.	Regional Office (Priority 1)
	M2	A proper ecological monitoring system for the Orange River will be designed and implemented to obtain the required ecological data needed to understand the system behaviour as soon as possible.	Regional Office (Priority 1)
	M3	The possibility of adjusting the releases from Vanderkloof Dam to improve the flow patterns must be investigated. The changes to the flow patterns must take into account, mouth closure requirements, water quality and the algal problem experienced in the lower reaches of the Orange River (see **Strategy 2.2**).	Dir NWRP (Priority 1)
	M4	Based on the data obtained from **M2,** determine the appropriate confidence level and timing for the determination of the ecological Reserve. A flow management plan should also be considered.	RDM (Priority 1)
References:	a) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) b) Lower Orange River Management Study (LORMS)		

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A.2.2 WATER QUALITY MANAGEMENT STRATEGY

Management objective:	The Department has a mandate to manage water resources in a sustainable manner. It is recognised that, in the pursuit to stimulate development and socio-economic growth, there will be a negative water quality impact on our environment. The main objective is therefore 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.
Situation Assessment:	**Surface Water** The water quality of the Orange River main stem is affected by the contributions from upstream viz the Vaal River, Modder Riet and the Orange River in the Upper Orange WMA. as well as by the irrigation activities along the Orange River within the Lower Orange WMA. The water quality issues are salinity, microbiological pollution and eutrophication due to elevated nutrients. Outbreaks of algal blooms occur along the lower reaches of the Orange River. These algal blooms have been identified as potentially toxic and are of serious concern. The approach to the management of water quality in other WMAs, is by developing water quality management plans, which specify Water Quality Objectives (WQO) as the mechanism to protect the water quality of the resource. In the Orange and Vaal River Systems, the WQO will have to be developed with full cognisance of downstream impacts to cater for the interdependence of the WMAs. A fully integrated water quality management plan would therefore be the only way to derive appropriate WQO in each WMA . Water quality monitoring stations are located on the main stem of the Orange river with very few located on the tributaries. The difficulty in collecting samples on the tributaries in this WMA is that the rivers are ephemeral and sampling can only be done if the personnel are in place at the time that the flows take place. The runoff water quality is likely to be similar to natural conditions as the land use has not changed substantially from natural conditions. Runoff also occurs infrequently in the area and therefore does not contribute significantly to the system. The toxic algal blooms that occur in the Orange River main stem are a public health risk. To address the problem, the Department has set up a monitoring program and a communication system through the Lower Orange River Remediation Forum (LORRF). The purpose of the monitoring program is both to identify the toxic algal blooms and to provide information to develop an understanding of the sources and behaviour of the algae. The current monitoring indicates that the likely source is from the Vaal River, possibly the Spitskop Dam on the Harts River. If the monitoring program identifies the presence of toxic algae, the LORRF is used to communicate and control management protocols and actions. The long-term management of the algae problem will be dealt with in the Integrated Water Quality Management Studies of the Vaal and Orange Rivers. In these studies the sources and sinks of nutrients will be identified and management actions formulated. The water quality data collected at the Douglas weir shows that the water quality is poor and concerns have been raised about the current management strategy at the weir. The poor quality emanates from the Harts River due to the return flows from the Vaal-Harts irrigation scheme and the irrigation downstream of the Spitskop Dam. There are further contributions from the irrigation areas downstream of the confluence of the Harts and Vaal Rivers. The Orange-Vaal WUA is responsible for the day to day management of the weir and a pilot project has been initiated to investigate pollution sources and pathways from agriculture and the water quality management strategy at

Situation Assessment (Continued):	the weir. The Institute of Groundwater Studies of the University of the Free State is also busy with studies in the area. The increasing salinity in the lower reaches of the Orange River is also of concern. The algae monitoring program has shown that there is an interaction between the types of algae, in particular the toxic algae, and the salinity. The elevated salinity provides an environment in which the toxic algae dominate. The elevated salinity is also an issue as sensitive crop types are grown in the area. The sources of the salinity are both local from irrigation return flows and poor water quality passed down from upstream. There is extensive irrigation practised along the banks of the Orange River. The extent of the return flows to the river and canal systems is not known, nor is the recharge of the groundwater from the irrigation areas and the transport of salt from the irrigation areas to the groundwater. The extent of the interaction between groundwater and surface water along the banks of the Orange River main stem, is also not well understood. Microbiological water quality problems are also associated with the return flows into the irrigation canals and main stem. A monitoring program has been established and the communication of public health risk is undertaken through the LORRF. The sanitation systems of the smaller towns in the WMA are inadequate or poorly managed. These systems need to be improved as they are threatening both the surface and groundwater quality. The WSDP and licensing process should be used to address these issues. There are mining activities taking place in the WMA such as the diamond mining along the coast. These activities do not currently present a problem to water quality and are managed through the EMPR and water use licencing processes. Large blue asbestos dumps are found in the Westernberg area. These mine dumps have been fully rehabilitated but might have health implications when inundated by a possible large dam at Boegoeberg. Indications from the LORMS study however is, that a large dam at Vioolsdrift will be more beneficial. **Groundwater** Groundwater is an important resource in the Lower Orange WMA. The groundwater quality varies from good to unacceptable in terms of potable standards. The majority of the WMA is categorised as class 3 to 4. There are also radioactivity, fluoride and nitrate water quality issues related to the groundwater in the WMA. The Water Research Commission has funded studies to investigate the radioactivity and nitrate issues. The results of these studies need to be passed on to the water users in the WMA. The zoning of groundwater quality in the WMA needs to be undertaken. The zones will provide the spatial extent of the water quality issues related to the groundwater. The zones will be the basis of the communication with the local authorities concerning groundwater quality issues as well as treatment options and groundwater management. Groundwater in the WMA should be protected and correctly managed. This is both from the quantity and quality point of view. Groundwater management plans should be developed by the local authorities. These plans should include the collection of monitoring information as input to the management of the groundwater system.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1** A management plan needs to be developed to address the issues related to the irrigation along the main stem of the Orange River. The issues that need to be addressed are the quantification of the return flow volumes and qualities, recharge of salt to the groundwater, interaction with surface water and the diffuse washoff loads.	Regional Office (Priority 1)
	M2 The existing algae study results need to be assessed and further studies planned to better understand the behaviour of the algae and sources so that management options can be developed and implemented.	Regional Office (Priority 1)
	M3 The sanitation system issues should be addressed through the WSDP and licencing processes as well as the communication network set up for the WMA.	Regional Office (Priority 1)
	M4 A map showing the groundwater zones in terms of radioactivity, fluoride and nitrates should be produced using the available data from the WRC studies when completed as well as from other data bases.	Regional Office (Priority 1)
	M5 The Department must promote sustainable water management at local authority level. The guidelines and protocols developed by the Department must be communicated to the local authorities.	Regional Office (Priority 1)
	M6 The use of the EMPR and water use licensing processes should be continued to manage the mining activities in the WMA. The diamond mining activities along the coast were mentioned as activities that needed particular attention.	Regional Office (Priority 1)
	M7 A literature review of water quality related studies that have been carried out in the Lower Orange WMA needs to be compiled.	Regional Office (Priority 2)
References:	a) Vaal River System Analysis Update-Summary Report (Report no. P C000/00/19496) b) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697)	

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A.3 WATER USE MANAGEMENT STRATEGY

A.3.1 INTERNATIONAL USE

Management objective:	Ensure that international water use is based on sound agreements among shared basin states and that current and future water use data are exchanged to facilitate efficient planning and management.
Situation Assessment:	This strategy is described in the Orange River Overarching ISP document (**DWAF, 2004a**). The Lower Orange CMA will only be responsible for operational arrangements with Namibia if delegated to them from the Overarching ISP. (Also see **Strategy A.1.5**)

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:		
References:	a) National Water Resource Strategy DWAF RSA, First Edition	

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A.3.2 GENERAL AUTHORISATIONS STRATEGY

Management objective:	To ensure that General Authorisations are used sensibly and effectively, reducing the administrative load but without detriment to the resource.
Situation Assessment:	**GENERAL** The Orange River main stem is part of a Government Water Control Area since 1977 and General Authorisations were therefore not required for the main stem Orange. Currently the General Authorisations applicable to the Lower Orange WMA is according to National General Authorisation publication No 398 dated 26 March 2004. No amendments to this publication were made for the Lower Orange WMA. Small diamond diggers are commonly found in the area and guidance is required with regards to the authorisation for water use to these diggers to ease the current licensing process. The extent and effects of small mining operations are not known. General Authorisation should be amended to include: ▪ Small mines (delwers). ▪ Recreational use such as rafters, jetty construction and canoeing. ▪ Groundwater abstractions for local supply, which could be agriculture or municipal. ▪ Sanitation discharge authorisations.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1**. The Regional Office needs to determine the general authorisations needed for the WMA and ensuring that they are developed and published.	Regional Office (Priority 1)
	M2. Revisit water uses (defined in Section 21 of the NWA) in the catchment and determine which can be generally authorised.	Regional Office (Priority 1)
	M3. Carry out a survey to determine the extent of small mining operations and their cumulative impact on water use, water quality and the river banks and bed. Design general authorisations to deal with this.	Regional Office (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition b) Notice number 1911 promulgated in Government Gazette No. 20526 dated 8 October 1999, providing the current General Authorisation Schedule.	

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A.3.3 LICENSING AND COMPLIANCE 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:	One of the most important water resource issues facing the WMA is the licensing of current and new water users and the licensing of water discharges (e.g. urban effluent returns, mines decanting groundwater, etc). The issuing of licences for water abstraction should be considered within the following framework: ▪ Apply the allocation priorities as defined in the Water Act. ▪ New abstraction licences supplied from the Orange River will have to be supported from additional intervention measures (See Orange and Vaal Overarching ISPs for a description of measures) and therefore have to bear the full cost of water supply from the Orange River System. This however excludes the 4 000ha already allocated to resource poor farmers and new licences as result of trading. ▪ In the tributaries, new abstraction licenses that do not have direct access to the main Orange River System will be assessed with respect to their impacts on local water resources and other uses. If the impacts are acceptable, a licence could be issued. ▪ All new license applicants will have to prepare plans of how water will be used effectively. ▪ Water quality impacts of any new licence must be assessed. ▪ When the trading of water allocations is considered, the existing trading policies should be applied. ▪ Allowing new abstraction licences may cause the date that intervention measures is required to be brought earlier. The impact thereof on the recommendation from the LORMS will have to be assessed on a continuous basis. The process of verification of the current registered irrigation water use has started but is not yet completed. Satellite imagery is used for verification purposes and the required tools for this process are already in place. The verification process was started in the areas where the most problems were being experienced. Non-compliance will be dealt with through prosecutions if necessary (see also **Strategy 1.2**)**.** The existing WARMS information management system will be used to manage water use licences data and capture data of the actual use / discharges of users.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** When individual applications are received, process according to the given framework. **M2.** Look continuously at ways to improve or streamline the licensing process. **M3.** The process of verification of registered use and seeking unlawful should be continued. **M4.** Monitor if the conditions (compliance monitoring) of the licences are in place. When the licence is reviewed in 5 years time and it does not comply with the conditions set, the licence might not be renewed.	Regional Office (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition	

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A.3.4 PRICING STRATEGY

Management objective:	Implementation of the water resource use charge as well as other types of charges (e.g. polluter pays charges) as a means of funding the management of water resources and future development.
Situation Assessment:	There is a National Pricing policy in place and the pricing of water use should be determined accordingly. A national policy for waste discharge charges is currently in the process of being developed. The principle is that polluters must pay for their impacts with the charges being used to manage the water quality in the WMA. In the case of the Lower Orange WMA, the water quality is also impacted on by upstream WMAs and upstream polluters should contribute to the water quality management in the Lower Orange WMA. There is a requirement for an organisational structure to support and manage these payments. (See overarching ISP document for more detail)

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:		

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A.4 WATER CONSERVATION & WATER DEMAND MANAGEMENT

A.4.1 WATER CONSERVATION & WATER DEMAND STRATEGY

Management objective:	To improve efficiency of water use by developing and implementing targeted measures to monitor and control demand. To make more effective and efficient use of the existing available water resources in all water user sectors. This will enable both DWAF and the future Catchment Management Agency to conserve this scarce resource and avoid expensive schemes for transfers and storage when these may not be necessary if demand is properly managed.
Situation Assessment:	Evidence of inefficient water usage can be found in all water use sectors throughout the country and the value of water still seems largely unrecognised by many water users. South Africa is a developing country that is water stressed and requires improved management of its limited water resources. The implementation of water conservation and water demand management practices is essential in meeting the national goals of basic water supply for all South Africans and the sustainable use of water resources. Comprehensive irrigation water demand management, or water conservation strategies and actions, were prepared for the Orange River Replanning Study (ORRS) in 1998. Irrigation is the main water user in this WMA and water conservation and demand management should be focussed on this user group to obtain maximum savings. Significant savings can be obtained by reducing conveyance losses in canals, proper irrigation scheduling, metering and pricing of irrigation water, as well as the improvement of irrigation systems. Although urban/industrial use is a relative small component in this WMA, Water Conservation and Demand Management Programmes or strategies for urban centres need to be reviewed or if necessary designed and implemented as these can have significant impact in some of the sub-catchments. This is specifically important for the larger mining towns where water to individual homes is not metered and people do not pay for their own water use. Groundwater is the only source of water for a large number of towns in the Orange Tributaries and Coastal sub-areas and Water Conservation and Demand Management Programmes is extremely important in these areas to protect the resource. There is a need to make small towns aware of WCDM as a source and not to first develop other new sources. WCDM also has a direct benefit to municipalities due to savings on source development costs and sewage treatment costs. There are currently several initiatives by Local Authorities and Service Providers, industries and mines to implement Water Conservation and Demand Management (WCDM) measures and it is perceived that significant savings could be achieved in the gross demand of the urban sector. The operational losses of 270 million m³/a with regards to releases from Vanderkloof Dam, can be regarded as an conveyance loss and reduction in these losses can result in significant savings. Measures as identified in the LORMS to reduce the 270 million m³/a operational losses, as well as other recommendations with regards to WCDM, should be evaluated and implemented The 4 000ha allocated to resource poor farmers in the Lower Orange represents only approximately 6% of the current area under irrigation. Further equity actions over and

Situation Assessment (Continued):	above the 4 000 ha will possibly be required in future. By saving 10% of the current irrigation demand through WCDM, 90 million m³/a can be made available for the irrigation of an additional approximately 6 000ha. There is currently only a small surplus available in the Orange River System after the water allocated to resource poor farmers is utilised and releases for the ecological requirements have been made. It can therefore be promoted that improved water use efficiency by irrigators be used to their own benefit. This includes the possibility of irrigation water savings being traded with other sectors. Only after the 4 000 ha has been fully utilised, will additional measures be used i.e. compulsory licensing to obtain more water for resource poor farmers. As part of this process inefficient users will be targeted rather than the efficient users. **Scope for savings:** Substantial scope exists for saving water through the implementation of strategies to improve efficiency of water use. E.g. - Water use especially in mining towns are in the order of 350l/c/d and can be reduced significantly. - Irrigation scheduling and farming practices10% savings. - Metering and pricing of irrigation water 10% savings. - Improvement of irrigation systems up to 27% This potential savings will be utilized by the irrigators to extend their area currently under irrigation. There are currently various WCDM initiatives undertaken in the areas supplied from the water resources in the WMA, however, what is lacking is a clear picture of what the impact will be on the water requirements in future. This information is essential to ensure intervention and operations planning are based on realistic water requirement projections. In the Overarching ISP for the Orange River Catchment the need was identified for a study to determine how the projected water requirements and return flows would be affected by WCDM measures. Work done in this regard and the relevant results from the LORMS should be incorporated in the proposed study.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** Irrigators can utilise savings as result of improved water use efficiency to their own benefit, on the condition that they can prove they comply with the licence conditions.	Regional Office (Priority 1)
	M2. Encourage small towns to consider WCDM as a first action before the development of new sources.	Dir NWRP (Priority 1)
	M3. Evaluate results and recommendations from the LORMS with regards to WCDM and take action as needed.	Regional Office (Priority 1)
	M4. Implement recommendations from the LORMS to reduce operational losses.	Regional Office (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition b) Orange River System: 2002 Hydropower Operating Analysis (Report no. 8350/06) c) DWAF & Eskom operational contract.	

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A.5 INSTITUTIONAL DEVELOPMENT & SUPPORT MAIN STRATEGY

A.5.1 CO-OPERATIVE GOVERNANCE STRATEGY

Management objective:	Co-operative governance (i.e. liaison and integration of planning between government departments, district and local authorities) needs to be factored into the overall integrated water resources management arena to ensure a compounded benefit to all users in the catchment.
Situation Assessment:	Efforts are made to have a networking system in place for communication with the District Municipalities, Provincial Government as well as the Department of Agriculture and Land Affairs. The District Municipalities discuss their projects with DWAF to obtain DWAFs input on priorities and content. The WSDPs are also discussed with DWAF at these Forums. Existing Forums include Namakwa, Karoo and Siyanda. Pertinent issues that have to be communicated to the District Municipalities relate to sanitation, water supply and water management. The Lower Orange River Remediation Forum (LORRF) has been set up to facilitate communication between the local municipalities and DWAF. The establishment of this forum has largely been driven by public health issues relating to the monitoring and management of potentially toxic algal blooms as well as microbiological pollution. Agriculture is widely practised in the WMA and is impacting on groundwater and surface water quality. The final allocation of irrigation areas to establish the 4000 ha for resource poor farmers should take place through the Co-ordinating Committee for Agriculture and Water (CCAW). The licencing and WC&DM issues relating to irrigators, also need to be communicated through the CCAW. There is mining taking place in the WMA. The environmental impacts of the mining are dealt with in the EMPR process of the Department of Minerals and Energy. The inputs from DWAF into this process is essential as far as management of water pollution impacts, water use licencing and water supply is concerned. DWAF needs to know the extent of future mining so that it can be incorporated into water resource planning.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.**The existing practise should be continued.	Regional Office (ongoing)
References:	a) National Water Resource Strategy DWAF RSA, First Edition	

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A.5.2 LOCAL AND CATCHMENT LEVEL STRATEGY

Management objective:	The Regional Office (as the interim CMA) needs to take institutional control of all Water Resource Management functions and will be supported by DWAF Head Office Directorates. The main objective is to responsibly manage the water resources of the Lower Orange WMA until such time as the Catchment Management Agency can take over some of the functions.
Situation Assessment:	Irrigation Boards 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. There are seven WUAs currently transforming from Irrigation Boards. The constitutions for these WUAs are being drafted. The viability of some of the existing Irrigation Boards is also being investigated and new WUAs are to be established particularly for Resource Poor Farmers. There is a public participation process underway informing stakeholders about the CMA. The process will allow stakeholders to make informed decisions when the CMA establishment process is started. The process of setting up Forums or structures, which will form the basis of the CMA, is starting. The Lower Orange River Remediation Forum (LORRF) has been established to assist with managing the algal and microbiological problems associated with the Orange River main stem.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** The process of setting up WUA and the process currently started to establish the CMA should be continued. This includes the establishment of new Forums and the optimum use of the existing Forums as a means of communicating with the public, District Municipalities and Water Sector Forums.	Regional Office (Priority 1)

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A.5.3 POVERTY ERADICATION

Management objective:	The main objective is to contribute to the eradication of poverty through the provision of basic Community Water Supply, to supply to viable Industrial/urban growth as well as to offer agricultural production, food and household security through water. Due to a significant rural composition of the population and dependence on agriculture, make specific allowances for irrigation water to resource poor farmers.
Situation Assessment:	The economy of the Lower Orange WMA is driven by agriculture and mining with these sectors employing the majority of the people in the WMA. A large proportion, 32% of the workforce, is unemployed. The mining sector will be relatively stable in the medium term but in the long term mines will start closing down. Water could play a role under these circumstances in providing economic opportunities. Small diamond digging operations also provide opportunities for employment. Expansion in the agricultural sector is limited by the availability of water and arable land. However water has been earmarked for the establishment of 4000 ha of irrigation for resource poor farmers. There are a number of initiatives, which address poverty and the well being of people in the WMA, in which the Department participates. These include: ▪ The poverty eradication budget of Working for Water. Partnerships have been formed with mines and Correctional Services to eradicate invasive alien plants. ▪ The spending of funds from the Premier's Office to eradicate the bucket system of sanitation and implement the National Sanitation Policy. ▪ The health and hygiene awareness campaigns. The Department is also involved with the Department of Agriculture with projects for Resource Poor Farmers (RPF). The Department will be giving input to the establishment of the 4000 ha allocated to the Lower Orange WMA for the development of RPF. Constructive, well-structured and viable development plans are required for the 4 000 ha allocation to RPF. Other initiatives that can be utilised by the DWAF to address poverty includes: ▪ Obtaining more water through the implementation of WC&DM to be used by RPF. ▪ Be aware of land restitution and make water available where possible to make these initiatives viable. ▪ Making water available for tourism and eco-tourism will also contribute to poverty eradication. The Department must work closely with other government Departments at the national and provincial level to identify poverty eradication initiatives. The Department will also support investigations into water i.e. sources, costs, etc.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** Continue to be involved in poverty eradication initiatives and continue to look for poverty eradication opportunities.	Regional Office (Priority 1)
	M2. Support the Department of Agriculture through the CCAWs and existing forums to undertake judicious planning of irrigation developments of the 4 000ha allocated to resource poor farmers in the Lower Orange WMA.	Regional Office (Priority 1)
	M3. Small diamond diggers should be assisted by using general authorisations to facilitate access to water. The smaller diggers are generally poor and cannot afford to wait long periods for licences.	Regional Office (Priority 1)
	M4. Support other initiatives with information on water availability.	Regional Office (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition b) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697)	

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A.6 ENVIRONMENTAL STRATEGY

A.6.1 ENVIRONMENTAL MANAGEMENT STRATEGY

Management objective:	Ensuring that there is a balance between the need for development (i.e. including all activities undertaken by DWAF) and the need to protect the natural and social environment for the benefit of all.
Situation Assessment:	Although a nationally applicable environmental strategy will be prepared for all the WMAs, a number of environmentally related issues and facts that are of importance to this WMA need to be mentioned. ▪ The Orange River estuary has been declared a transborder Ramsar wetland and there are plans to expand the boundaries of the site. As result of hydropower generation with surplus water during winter months, too much water is entering the estuary in these months. This problem will however disappear over time as the available surplus has almost reduced to zero. (Also see **Strategy Table 2.1**). ▪ Actions from mining development and more specifically the small diggers might be in conflict with the environmental management strategy. This also applies to the possibility of small hydropower developments along the Orange River. ▪ An Arid Zone Ecological Forum has been established to address the large pan areas. ▪ It is important that the Ai-Ais / Richtersveld Trans Frontier Conservation Park (TFCP) should be aware of development along the Orange River which might result in potential conflict. The real need for development in this area is also high and should be taken into account. ▪ Possible future large infrastructure development along the Lower Orange might be a re-regulation and/or a large storage dam near Vioolsdrift or at Boegoeberg. Results and recommendations from the LORMS will provide more detail in this regard.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	The reader is referred to **Chapter 1 Paragraph 1.5** of this report with regards to DWAF's responsibility.	

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A.7 INFRASTRUCTURE DEVELOPMENT & MANAGEMENT MAIN STRATEGY

A.7.1 INFRASTRUCTURE DEVELOPMENT & SUPPORT STRATEGY

Management objective:	Provision of adequate water resource development infrastructure (storage) and bulk water supply infrastructure to sustain and encourage social and economic growth.
Situation Assessment:	**General** With the introduction of the Municipal Systems Act and the emphasis on sustainable development in the municipal IDP planning process, there may be some development in the towns. Although there are a high number of small towns in the WMA, it is expected that the impact of these developments on the water resources will be relatively small, as the total urban/industrial requirement in the WMA is low and most of the people has opted the route of dry sanitation due to affordability and the availability of water. **Planning approach** A holistic planning effort is also required to identify the optimum bulk water storage and supply infrastructure layout that will make optimal use of the local water resources in the Lower Orange River WMA. Development options to supply in the possible future water requirements from the Orange River main stem are discussed in detail in the Orange River Overarching ISP (**DWAF, 2004a**) The possible developments in Namibia along the common border can have significant impacts on the water availability. The impacts of these developments on the water resources of the Orange River need to be assessed and should be illustrated clearly in results from the LORMS study. The existing Permanent Water Commission should be used to communicate RSA's and Namibia's requirements in terms of the developments. **Situation Assessment** There are currently no major dams on the main stem of the Orange River within the Lower Orange WMA, only several diversion weirs of which Boegoeberg is the largest. Two larger dams are located on the main tributaries and includes: ▪ Smartt Syndicate Dam (101 million m³ storage) on the Ongers River. ▪ Van Wyksvlei Dam (143 million m³ storage) on the Carnarvonleegte. No future dams are currently considered or planned in any of the tributary catchments. Vanderkloof and Gariep dams are located in the Upper Orange WMA but are used as the main source of water supply to the Lower Orange WMA. The utilisation of the lower level storage in Vanderkloof Dam is expected to be the first development option to be utilised when shortages start to occur in the Orange River System. This is expected to occur not to far in the future and depends on the rate of developments for resource poor farmers, irrigation in Namibia and the implementation of an updated EFR.

Situation Assessment (Continued):	Development in the Lower Orange WMA such as a re-regulating or storage dam at Vioolsdrift or Boegoeberg will have a direct positive effect on the availability of water in the Lower Orange WMA due to significant reduction in operating losses. These possibilities have been investigated as part of the LORMS. Clarity on which of the proposed LORMS developments will be taken further will be given at National level according to National Planning. Possible options (See Orange River Overarching ISP (**DWAF, 2004a**)) that are considered in the LORMS include: ▪ Utilising the Lower Level storage in Vanderkloof. (A separate and more detailed study with the emphasis on the effect on hydropower generation is also currently in process). ▪ Utilising spills from the Vaal River by means of real time modelling and simultaneously increasing the efficiency of the system operation. ▪ Decrease operational losses by means of re-regulation dams at Boegoeberg or Vioolsdrift. ▪ Large Storage Dam at Boegoeberg or Vioolsdrift to capture local runoff and Vaal spills. ▪ Making more water available through WCDM. Other possible future developments at WMA level include: ▪ Small hydropower plants along the Lower Orange River. This development option will not impact on the water availability in the system. ▪ Infrastructure to recharge groundwater and typically includes small dams and pipelines transferring water from the dam to boreholes located in the area of recharge for the main production boreholes. This will be the responsibility of the Local Authority and DWAF will only ensure that it complies with the NWA. ▪ Water supply to Mier in the Kalahari from the Lower Vaal (Mainly a social political decision). All boreholes currently under government control are to be transferred to local authorities, and this process is expected to be completed within the next two years.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** Evaluate results from the LORMS and take the required actions to follow up.	NWRP (Priority 1)
	M2. Support water resource developments at WMA level with information on water availability.	Region (Priority 2)
	M3. Complete the transfer process of government controlled boreholes to local authorities.	Region (Priority 1)
References:	a) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) b) Lower Orange River Management Study (LORMS)	

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A.7.2 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 the development of new costly infrastructure through increased efficiency while also saving operating costs over the short-term. Optimise the utilisation of the water resource by allowing maximum hydropower generation without adversely impacting on either the ecology or the reliability of supply to the users in the system.
Situation Assessment:	The management of the Main Orange River System is done on an overarching level with a detail description given in the Orange River System Overarching ISP (**DWAF, 2004a**). Operating analyses for the Orange River System are undertaken on an annual basis to determine the surplus available in the Orange River System, which can be used for the generation of hydro-power over and above that released for normal downstream requirements. The operating analyses are also used to indicate the extent of curtailments that need to be imposed on the system during drought conditions. One of the most important measures to improve the system management is to reduce the operating losses by means of real time modelling and/or the use of a re-regulating structure in the Lower Orange. Estimations are that the current operating losses can be reduced from the current 270 million m³/a to 100 million m³/a (See Orange River System Overarching ISP (**DWAF, 2004a**). Other aspects of the current operating rule for the main system that directly impacts on the Lower Orange WMA is the release pattern from Vanderkloof Dam. Eskom currently releases surplus water mainly in the winter months for hydro-power generation, which is in conflict with the river mouth requirements as closure of the river mouth is required from time to time. Although this problem will disappear over time as the surplus decreases, discussions with Eskom in this regard can contribute to improve the current situation. There are algal blooms experienced in the main stem due largely to irrigation return flows, diffuse sources and poor quality water from the upstream Vaal WMAs. The management of the patterns of the ecological flows should also be considered to improve the management of the algae. The Smartt Syndicate and Van Wyksvlei dams are currently managed and maintained by the Irrigation Boards (IB). Spesific operating rules are used by the IBs to manage these dams.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** If a change in the ecological flow pattern is found to be a viable algal management tool, develop a suitable strategy and determine the feasibility of achieving the required pattern from a reconciliation point of view and implemented if feasible.	Region & WRPs (Priority 1)
	M2. Discuss the impact of the surplus releases for hydro-power generation during the winter months on the environmental requirement of the estuary with Eskom, to obtain an acceptable solution for both needs.	WRPs (Priority 1)
	M3. Evaluate results from the LORMS and implement as required.	WRPs (Priority 1)
	M4. Record existing rules and monitor if these rules are implemented. These rules as well as possible new rules must be verified by means of a system analysis.	WRPs (Priority 1)
	See ISP Orange River Overarching document (**DWAF, 2004a**) for management actions relating to the main system.	
References:	a) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) b) Lower Orange River Management Study (LORMS) c) Orange River System: 2002 Hydropower Operating Analysis (Report no. 8350/06) d) DWAF & Eskom operating contract	

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A.7.3 PUBLIC HEALTH & SAFETY STRATEGY

Management objective:	The water resource needs to be protected. Users must be safe from the effects of poor water quality that can create health problems (e.g. toxic algea). Strategies must be in place to deal with floods and droughts, as these impacts on the socio-economic environment.
Situation Assessment:	The Department's current commitments are associated with: Managing floods and drought disasters by direct intervention on the ground. ▪ Reducing pollution and preventing serious or hazardous pollution events ▪ Promoting dam safety. DWAF's (and the CMAs) future commitments under the National Disaster Management Act, which was promulgated in 2003, will be: - DWAF/CMA are required to become involved in supporting disaster management planning by all relevant authorities. - Drafting a National Flood Management Policy (DWAF). - Dam safety policy (Currently DWAF but responsibility will be transferred to WUA). - Co-operating with the Department of Agriculture on drought relief strategies and policy formulation. - Pollution control of water resources (i.e. limiting health hazards such as cholera, fluoride/chloride heath problems and algae blooms). The toxic algal blooms that occur in the Orange River main stem are a public health risk. To address the problem, the Department has set up a monitoring program and a communication system through the Lower Orange River Remediation Forum (LORRF). The actions of the LORRF must be continued in monitoring, communicating and managing public health risk arising from toxic algal blooms and microbiological health (See **Strategy A.2.2**). Blackflies is still a problem along the Orange River but is currently under control. No additional releases from Gariep and Vanderkloof dams are required for this purpose. The only requirement is that a constant flow rate is required in the river over a period of ± 14 days during the application of larvicides. These actions are currently controlled by means of a Task team appointed for this purpose, with involvement of DWAF and the Department of Agriculture. Flood and drought management at Gariep and Vanderkloof Dams is discussed in the Orange River System Overarching ISP (**DWAF, 2004a**).

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** Compliance with the above-mentioned requirements.	Region (Priority 1)
References:	a) National Water Resource Strategy DWAF RSA, First Edition NWRS	

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A.8 MONITORING AND INFORMATION MANAGEMENT STRATEGY

Management objective:	The design and implementation of effective monitoring networks and repository databases to ensure adequate quantification of the balance between sustainable water use and protection for surface freshwater bodies and groundwater.
Situation Assessment:	**Water use control** Irrigation is by far the main water user in this WMA and very little data is available on the actual water use by and return flow from irrigation, as irrigation abstractions are not gauged. On the larger irrigation schemes the releases into the main canals is often available but no measurements of the outflow at the canal end is available. **Monitoring networks and data capturing** Monitoring is required for all aspects of water resource management from local, to catchment, to WMA to National level. Other institutions than DWAF such as Local Authorities, Industries, Universities etc. also do monitoring work. The data collection is therefore largely uncoordinated and results in unnecessary duplication and gaps in data. It is important that proper coordination should take place. **Resources** currently available for monitoring are generally inadequate throughout all existing systems. Some notable issues in the ISP-area are briefly discussed below: Groundwater monitoring includes water levels and ambient water quality. There are automatic data loggers at some stations but the time dimension is not included in some of the available data. Monitoring needs to be extended together with the proper management of the groundwater resources. Over utilisation of boreholes is a problem and a definite need for proper water use control exists. Groundwater monitoring is also inadequate although the groundwater potential is very important in this WMA. Monitoring is required to enable improved management. The calibration of the salinity model for the Orange River proved very difficult due to problems with the available water quality data and specific recommendations were given in the relevant report to DWAF with regards to a water quality monitoring programme in the WQ reports. Most of the stream flow gauges (± 10 gauging weirs in total) in the Orange River downstream of Vanderkloof Dam are inaccurate at low flows. Low flow conditions occur most of the time under normal operating conditions where the river flow is mainly dependent on releases from Vanderkloof Dam. This makes it extremely difficult to operate the system and to release the correct volume from Vanderkloof without resulting in excessive losses or some times in shortages. Operating losses of 270 million m^3/a currently experienced in the system is partly due to the inaccuracy of flow gauges at low flows. Obtaining the required flow to meet the river mouth environmental requirement, particularly at low flows is hardly possible. Details of the various data related problems and shortcomings is given the recommendations of the relevant study reports and should be consulted to evaluate and prioritise the monitoring needs. The most prominent problem areas relevant to this WMA have been mentioned above.

Situation Assessment (Continued):	**Information Management** To be considered at National Level. At local level the Regional office / CMA should co-ordinate all the monitoring needs in the WMA. Some of these needs will be required at a National level while others will be related to requirements at local level.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** As part of the Overarching ISPs a need was identified to undertake an assessment of all the monitoring needs to support Integrated Water Resource Management in the Vaal and Orange river catchments. The most important needs are given in the situation assessment of this strategy. Details of the monitoring needs must be obtained from the recommendations given in the relevant study reports as well as inputs from the Regional Office and CMAs. As part of the audit function of the WMA it is also required to know how much water is flowing into and out of the WMA. Co-ordination should be done at WMA level. (See Orange River Overarching ISP (**DWAF, 2004a**))	Region (Priority 1)
	M2. Develop a strategy and action plan to monitor and control irrigation water use. This can typically include the use of aerial photography and satellite images initially, which can be followed by actual metering at a later stage.	Region (Priority 1)
	M3. Develop a co-ordinating system for integrated management of monitoring requirements. (The CMA or Region is the best suited to specify the requirements and to co-ordinate the needs).	Region (Priority 1)
	M4. Develop a Lower Orange Information Office.	Region (Priority 1)
References:	a) Orange River Development Project Replanning Study Main Report. (Report no. P D000/00/6697) b) Orange River System Analysis Phase 1 & 2 (Report no. P D000/00/1092) c) Vaal Augmentation Planning Study: Calibration of Water Quality Model for Orange River Catchment (Report no. P C000/00/15896)	

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A.9 IMPLEMENTATION MAIN STRATEGY

Management objective:	To ensure that the approaches put forward by the Department through this ISP are adopted and implemented in the Lower Orange River WMA. This will require willpower, funding and capacity.
Situation Assessment:	The ISP is an internal document, developed by the Department of Water Affairs and Forestry. The ISP sets out the approaches, which the Department is taking towards water management in the Lower Orange River WMA and list, suggested actions towards achieving good management of the water resource. The wider public has had no direct input into this ISP – yet it is recognised that the approaches adopted have a significant impact on the populace of the Lower Orange River 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 it sees the situation, and the steps which it views as most appropriate in dealing with the situation. 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. The ISP is guided by the approach set out in the NWRS – and details this approach for the Lower Orange River WMA along with improvements in information. The ISP 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. 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. The Implementation of the ISP is an enormous task and will have to be tackled in a stepwise fashion. Much of what is in this document describes the day-to-day functions of the Department – but there are many new tasks, functions, and actions set out in response to DWAF's visions for the future. It is recognised that it is quite impossible to immediately launch into, and achieve, all that is required by this ISP. Funding and capacity are both real hurdles. 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. The position with regard to the Authority of Information contained in the ISP is set out in **Paragraph 1.3.4** of **Chapter 1** of this ISP document.

MANAGEMENT ACTIONS		
Required actions, responsibilities and priorities:	**M1.** Publish the ISP to be accessible for public input and comment with both hardcopy and web-based options. Copies will be presented to key stakeholders on request. It is not the intention to have a major drive for public input, but merely to create accessibility for input.	Regional Offices (Priority 1)
	M2. All Regional staff, District Authorities, Working for Water, Eskom, and other major stakeholders should have access to, or copies of, the ISP.	Regional Offices (Priority 1)
	M3 There are many actions in the ISP, which do require public involvement – and it is important that the thinking with regard to, for example, the use of groundwater, and the importance of WCDM, is taken out forcefully both to local authorities, other direct water users such as agriculture, and the wider public.	Regional Offices (Priority 1)
	M4. Collate comment and consider this in revising and improving the ISP.	Regional Offices (Priority 1)
	M5. There is a need to develop materials suited for the preparation of the Provincial Growth and Development Strategy, and other regional, provincial and local planning activities. Materials should support the preparation of WSDPs, land use and agricultural planning, and land reform initiatives etc.	Regional Offices (Priority 1)
	M6. The ISP should be open to continuous improvement and updated regularly.	Regional Offices (Priority 1)
	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 will be done as required.	Regional Offices (Priority 1)
	M8. The practicalities of implementation demands must always be considered.	Regional Offices (Priority 1)
	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	Regional Offices (Priority 1)
Implementation	The implementation is to be ongoing until the Upper and Lower Orange River WMAs is established and the ISP is superseded by a CMS	

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Appendix B

Groundwater Overview for Lower Orange Water Management Area

DEVELOPMENT OF INTERNAL STRATEGIC PERSPECTIVES

GROUNDWATER OVERVIEW FOR LOWER ORANGE CATCHMENT MANAGEMENT AREA

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1 Overarching Issues

The following is a brief description of the major groundwater issues in the Lower Orange Water Management Area (WMA). For more detailed information please refer to the references and the sources of data referred to in Section 1.

1.1 Availability of groundwater information in the catchment area

The following data sources with regard to groundwater are available:

- NGDB database
- WARMS data base
- DWAF Geohydrology Northern Cape
- GH Reports
- 1: 5000 000 Geohydrological maps and brochures
- Consultants reports and other academic reports

The NGDB is heavily populated with groundwater data for the WMA. There are over 400 points currently being monitored throughout the Northern Cape (including the Lower Vaal WMA). Most of the data are related to water supply schemes and ambient water quality monitoring.

The WARMS database also contains valuable information with regard to large-scale abstraction for water supply schemes and irrigation. Verification of the data still has to be performed.

The Geohydrology offices in the Northern Cape also has good data on groundwater utilization and the natural quality of groundwater due to the close relationship with ongoing water supply projects and other groundwater investigations. Another vast source of information is from GH reports (> 500) and the 1: 500 000 geohydrological maps completed for the region by the Geohydrology Directorate.

Several consultant reports and academic reports are also available. PD Toens and Associates have been involved in ongoing monitoring of groundwater resources in the Northern Cape for a number of years.

1.2 Overview of groundwater resources and use throughout the catchment area

1.2.1 Industrial and mining

Mining plays an important role in the WMA's economic development. Several diamond mines are located in the WMA including the Kleinzee, Alexcor and Hondeklipbaai mines. Diamonds are recovered at these mines from alluvial deposits. A number of small-scale diamond diggings are also found in the area. Some impacts do exist with regard to localized dewatering of aquifers. These impacts are however localized and very little data exist in this regard. Black Mountain base metal mine utilizes surface water from the Orange River for processes and no data is available on the water resource utilized by the Okiep Copper Mines.

1.2.2 Agriculture

Most farming settlements are dependent on groundwater for domestic and stock watering use. The groundwater resource is of such a nature that it cannot be utilized for large-scale irrigation throughout the WMA, except in the areas underlain by dolomitic aquifers. Volumes of total abstraction are available for this use.

1.2.3 Domestic

As discussed above, groundwater is utilized for individual domestic use in most rural and farming areas. Groundwater is the most important resource for bulk water supply in areas located far from the surface water bulk supply network. The naturally poor quality (See Section 1.3.1) and

poor yields of some aquifers are a constraining factor in the utilization of this resource. This is overcome in some areas by good water management practices and treatment of the groundwater.

Data received from DWAF (see Table 1) estimate the total abstraction for groundwater at 10 mil m^3 per year for domestic supply for approximately 100 000 inhabitants dependant on the source (DWAF, 2003). The majority of the water (43%) is abstracted from the granite and gneiss aquifers (See Section 2), 25% is from the Dwyka and Ecca Karoo sediments, 17 % from the Beaufort Karoo sediments and the remainder is abstracted from the dolomites (6%) and other primary aquifers (2%).

1.3 Groundwater quality in the catchment area

1.3.1 Natural

Groundwater quality is one of the main factors affecting the development of available groundwater resources. Although there are numerous problems associated with water quality, some of which are easily corrected, total dissolved solids (TDS), nitrates (NO3 as N) and flourides (F) are thought to represent the majority of serious water quality problems. The water quality was evaluated in terms of TDS and potability. The information was obtained from DWAF Geohydrology. The potability evaluation done was based on the evaluation of chloride, fluoride, magnesium, nitrate, potassium, sodium, sulfate and calcium using the Quality of Domestic Water Supplies, Volume 1 (DWAF, 1998).

The portion of the groundwater resources considered to be potable has been calculated as the portion classified as ideal, good and marginal (Class 0 -blue, 1- green and 2 - yellow) according to the classification system given in Section 6.4.1. Water classified as poor and unacceptable (Class 3 - red and 4 - purple) is considered not to be potable (See **Point and** diffusive pollution

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 needs 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 most concern, 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. High-density cultivation at surface water irrigation schemes along the Orange River contributes to the nitrate load of localized aquifers in the WMA. 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.

Table 2).

The mineralogical groundwater quality in the Lower Orange Water Management Area is not particularly good in terms of its TDS rating. In general the groundwater quality is rated as class 2 to class 4, marginal to completely unacceptable. The southern portion of the inland region, De Aar, Victoria West and Sutherland has a class 2 rating, together with the areas surrounding Prieska, Griekwastad, Upington and Springbok. The rest of the WMA, particularly north of Brandvlei and Carnarvon and the coastal strip are rated as class 3 and 4. The Sutherland, De Aar, Upington belt has a varying range of potable groundwater from a moderate 50% to approximately 90%. The balance of the WMA, has a predominant potable usage of less than

30%, with the occasional improvement to 50% (V3, 2002). See Figure 1 for average TDS values for the area under investigation as mapped by Simonic (1999).

Natural occurring radioactivity is found in some of the groundwater resources associated with geological formations such as granites and gneisses. Fortunately the values are mostly low except at Kotzerus, Kharkams, Bulletrap, Fonteintjie, Kenhardt and Riemvasmaak, which fall into Class 2 according to the potable water classification (Van Dyk, 2003).

Table 1 Groundwater consumption, population and quality of dependant communities in the Northern Cape

Community	Population	Consumption m^3/day		Average consumption	
		Winter	Summer	l/p/dag W	l/p/dag S
Brandvlei	2200		245		111
Britstown	6500	993	1124	153	173
Calvinia	8000	1131	1820	141	228
Carnarvon	6000	714	900	89	150
De Aar	29600	7000	8900		301
Fraserburg	3500	280	527		151
Groot Mier	250		35.25		141
Hanover	5200		733		141
Klein Mier	370		52.17		141
Loeriesfontein	2400	110	181	46	75
Loubos	500	40	50		100
Loxton	800		180		225
Niewoudville	1400	80	286	57	204
Noupoort	6100	928	1433	46	235
Rietfontein	1700	138	215		126
Strydenburg	2300	176	220	77	96
Sutherland	2600		366.6		141
Van Wyksvlei	1800	302	424	167	236
Victoria Wes	10000		1457		146
Vosburg	650		91.65		141
Welkom	241		33.981		141
Williston	2800	444	655	158	234
Bankara Bodulong	5520	414.2	621.2	75	113
Buffelsrivier	1200	66	96		80
Bulletrap	315	34	57		181
Campbell	2800		60		21
Colesberg	14000		1588		113
Danielskuil	2700		380.7		141
Deben	5748		125		22
Dibeng	300		42.3		141
Eksteenfontein	600	32	42		70
Garies	2000	140	260		130
Griekwastad	5200		616		118
Groenwater	300		42.3		141
Holpan	1200		72		60
Hondeklipbaai	1300		183.3		141
Jennhaven	200		28.2		141
Kammasies	369		52.029		141
Kammieskroon	1800	94	253.8		141
Karkams	1692	240	251		148
Kenhardt	4000	300	800	75	200
Kheis	670	18	25		37
Khubus	2254	136	177		79
Kleinzee+GM	3640		513.24		141
Klipfontein	663		7		11
Koingnaas	1500		211.5		141
Kommagas	3976	393	467		117
Kono	200		28.2		141
Lekkersing	600	48	56		93
Leliefontein	842	45	61		72
Majeng	300		42.3		141
Marydale	2550	118	238		93
Niekerkshoop	2000		282		141
Nourivier	470	19	30		64
Onseepkans	600		84.6		141
Paulshoek	836	15	16		19
Philandersbron	530	35	110		208
Pofadder	5450	Pyplyn	768.45		141
Richmond	6000	475	713	79	119

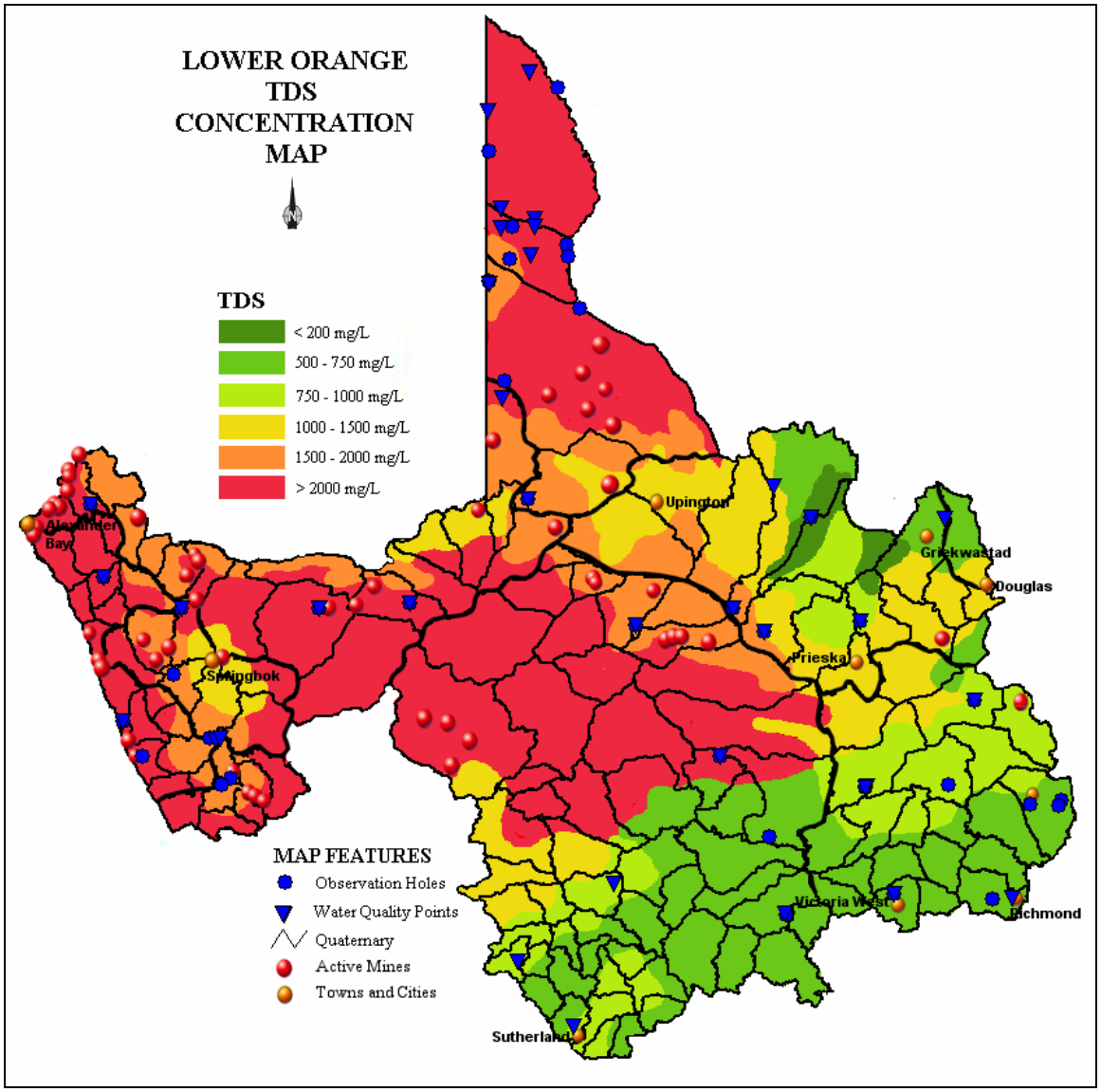

Figure 1 Mapped TDS values within the WMA

1.3.2 Point and diffusive pollution

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 needs 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 most concern, 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. High-density cultivation at surface water irrigation schemes along the Orange River contributes to the nitrate load of localized aquifers in

the WMA. 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.

Table 2 Water qualities of groundwater resources utilized by some communities in the WMA (from DWAF –Geohydrology)

Settlement	pH	N	F	$CaCO_3$	Na	Mg	Si	PO4-P	SO_4	Cl	K	Ca	Ec	TDS
Kotzesrus	8.0	0.94	1.8	158	2792	262	15.5	0.014	734	5541	25.1	745	1590	10297
Garies	8.2	2.18	0.6	132	430	77	10.9	0.089	149	827	8.6	99	313	1762
Paulshoek	7.7	<0.04	0.5	105	136	25	8.6	<0.005	53	236	3.5	42	101	625
Leliefontein	7.6	<0.04	2.1	71	24	6	18.4	<0.011	17	45	1.1	30	35	212
Nourivier	7.9	1.73	2.5	77	49	11	14.1	0.013	28	82	0.9	27	50	302
Kharkams	8.0	0.33	3.6	150	222	56	15.8	0.009	132	468	5.8	95	194	1167
Kammieskroon	7.8	0.89	1.2	169	270	90	12.6	<0.005	116	763	5.1	167	278	1621
Komaggas	8.5	2.93	0.6	116	191	53	13.4	0.009	78	382	8.7	38	159	906
Lekkersing	8.2	5.07	0.5	156	459	84	8.5	0.010	180	849	14.5	100	325	1901
Eksteenfontein	8.0	3.15	0.4	167	254	71	10.8	<0.005	132	576	8.6	101	237	1361
Khubus	8.0	0.33	0.5	140	262	43	20.8	<0.005	94	739	16.3	21	265	1539
Kosies	6.9	2.82	0.3	45	93	14	25.1	0.010	34	133	5.1	13	69	360
Eyams	7.2	3.58	0.4	28	69	12	16.7	<0.005	22	128	4.8	14	52	300
Gladkop	8.2	2.28	1.3	139	206	93	12.2	0.006	118	659	4.4	136	249	1398
Bulletrap	8.0	4.82	3.5	178	566	121	16.6	0.017	410	1257	5.4	290	487	2891
Fonteintjie	7.3	4.61	1.1	76	92	20	16.9	0.011	113	153	1.8	49	90	544
Kenhartd	8.2	1.26	2.4	237	131	25	16.2	0.005	118	180	2.5	89	112	843
Riemvasmaak	8.1	6.26	3.6	445	122	31	18.7	0.006	60	59	6.9	99	115	952
	8.1	11.07	6.4	365	466	26	17.9	0.006	336	360	5.1	71	246	1764
Marydale	8.1	15.43	1.2	287	159	45	31.5	0.013	119	167	16.8	55	140	982
Loubos	8.4	1.74	1.1	235	60	9	9.9	<0.005	32	11	1.0	51	54	459
Welkom	9.0	19.39	2.2	495	510	5	12.8	0.015	163	283	6.0	6	233	1663
Klein Mier	8.5	10.32	1.7	505	292	6	22.6	0.009	49	76	4.7	12	133	1103
Groot Mier	8.6	40.87	5.5	941	1093	12	20.4	0.113	358	547	8.9	11	472	3365
Philandersbron	8.2	7.62	0.9	362	144	24	11.1	0.014	169	82	1.1	110	125	1006
Rietfontein	8.1	7.16	0.9	393	117	33	14.3	0.007	75	118	1.2	106	122	962
Noenieput	8.2	39.68	1.6	436	387	47	11.4	0.006	251	439	3.0	172	290	2008

Activities related to urban areas can also result in localized or even diffuse pollution of groundwater. Poor management of sewage treatment works can contribute to the groundwater pollution as can landfill sites, on-site sanitation (especially in informal settlements) and spills resulting from accidents or leaking underground tanks.

Uncontrolled dumping and accidents related to the transport industry also contribute to localized pollution in the WMA. Often goods that contain hazardous substances or perishables are confiscated by authorities and these are then dump at illegal sites. A need for incinerators has been identified.

Mining activities that impact on the groundwater quality include the Okiep Copper mine and the Black Mountain lead, zinc, copper and silver mine.

Mineralisation in the O'okiep area tends to occur in basic rocks intruded in the form of 'steep structures' into granitic terrain of the Namaqualand Metamorphic Complex, and may extend to depths of over 1000 m (www.metorexgroup.com/Ookiep.htm). The major copper minerals are bornite (Cu_5 FeS_4) with 62% copper, and chalcopyrite ($CuFeS_2$) with 32.5% copper. Open stoping is employed at the mine, together with backfilling at times at O'okiep. Ore is concentrated by flotation and transported to the nearest available smelter. O'okiep smelts its own concentrates. The Black Mountain Mine is situated in the Northern cape near Aggeneys. The facility produces zinc concentrate together with lead and copper concentrates, from which silver is also recovered. Development of the nearby Gamsberg zinc deposit, is currently under consideration (http://www.dwaf.gov.za/orange).

There are many impacts on the environment dealing with the water quality and waste disposal from copper mining. These adverse water quality impacts are caused primarily by land disposal practices that fail to contain wastes, by run-on and run-off controls that are inadequate to prevent surface water from flowing through impoundments, or by groundwater infiltrating surface impoundments. These open-pit mining methods also can cause disturbances that can lower the water table in an area, causing water shortages, land subsidence, and fracturing. However due to the low rainfall in area the impacts on the groundwater quality are less than expected and very localized. Acid Mine Drainage, elevated TDS, SO_4, and low pH with associated higher trace metal concentrations have been found at tailings dumps.

A radioactive waste disposal site for low- and intermediate level waste generated at the Koeberg Nuclear Power Plant, is located north of Springbok on the flat plains of the Bushmanland plateau. Waste is buried in metal drums and solidified in concrete in the trenches. Up to date no significant contamination of the groundwater has occurred (Van Blerk, 2000).

Sprinkbok Hard Chrome is an industry located in Springbok, an incident has occurred where Cr^{+6} was released into the environment but no data is available on the impact the incident had on the groundwater resource.

As discussed in Section 1.2.1 impacts on groundwater quality from the diamond mining industry in the WMA is negligible.

1.4 Groundwater management and monitoring requirements in the catchment area

1.4.1 Current groundwater monitoring and management

There are a total of approximately 400 monitoring points throughout the Lower orange and Lower Vaal WMAs. The monitoring points serve all two of the levels of groundwater monitoring namely level 1 or national monitoring network and level 2 or regional. Some points are shown of Figure 1. The monitoring includes water levels and ambient water quality. There are automatic data loggers at some stations. The aim is to expand the network to approximately 500 but the required equipment and personnel is currently not available. The required expansion as well as reporting and individual user reporting could be solved with the establishment of WUAs. However up to date no WUAs has been established in the Lower Orange WMA.

Individual permits and licenses is another management tool, which are used at large scale abstraction points. This is mainly restricted to municipal and mine users. Compliance monitoring is required by these licenses.

DWAF Regional office has received several license applications by individual users, but these are mainly for irrigation purpose in the Lower Vaal WMA. One groundwater reserve (D56B) has been completed in the Lower Orange WMA.

1.4.2 Current (quality and quantity) requirements

No formal quality and quantity requirements have been set to date but DWAF is in the process of addressing the issue.

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

Often groundwater is an inexpensive resource to develop 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. DWAF Geohydrology is actively involved in water supply schemes for domestic use from groundwater resources in the WMA. In total it comprises 30% of all exploration and development work done by the regional Geohydrology section. The ambient water quality of the resources is however a problem when developing water supply schemes for communities and the health implications of this water supply needs to be considered.

Emerging farmers can also benefit by the exploitation of groundwater but the potential for irrigation development from groundwater resources in the WMA is limited. Livestock farming could be in option in this regard, but DWAF considers this type of development to be the Department of Agriculture's responsibility.
Working for water are currently clearing invasive prosopis and thus contributing to poverty eradication, invader eradication and improvement of water resources in the WMA.

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

The Lower Orange WMA, is underlain by very diverse lithologies. Several broad lithostratigraphic units fall within the boundaries. A simplified geological map of the WMA is presented in Figure 2. From oldest to youngest these units comprise the following (V3, 2002):

- **Namaqualand-Natal Basement Complex**. Rock of this complex, ranges from homogenous granites through to migmatites and gneisses. The area underlain by the Namaqualand-Natal Complex is situated in the vicinity of the Orange River between Upington and Springbok. The area is an assembly of compact sedimentary, extrusive and intrusive rocks.
- **Ventersdorp Supergroup**, represented by andesitic lavas and occasional sedimentary rocks related to post extensive erosion, are encountered in very small 2-5 isolated inliers between Prieska and Douglas.
- Dolomitic and related carbonate rocks of the **Postmasberg Group, Campbell and Griquatown Sequence, all forming part of the Griqualand West Sequence**, occupy the north-eastern lobe of the WMA. Dolomites, limestones and related sedimentary rocks (often iron or manganiferous ore bearing) make up this broad lithostratigraphic unit.
- **Abbabis and Kheis Groups** are represented by relatively small inliers of diverse sedimentary successions consisting of shales, sandstones, banded iron formations and conglomerates. These rocks are encountered in the vicinity of Upington and are not widespread.
- **Damara Sequence** encountered in the immediate vicinity of Alexander Bay and Port Nolloth, is represented by the Fish River, Schwarzrand, Kuibis, Malmesbury, Gariep, Swakop, Otavi, Nosib, Rehoboth and Sinclair Groups. Lithologies in these various groups are very diverse, ranging from shales, sandstones, diamictites, banded iron formation through to limestones and calcareous sedimentary formations.

- **Karoo Sequence** represented by the Ecca Group and Dwyka Formation, and to a lesser extent the Beaufort Group, occupy the southern lobe of the WMA, and comprises thick successions of sedimentary rocks. Sedimentary rocks range from mudrocks through coarser varieties (sandstones, conglomerates) to diamictites and rhythmites (pleistocene deposits). Karoo or Jurassic dolerite is fairly common throughout the sequence and also frequently intrudes older rocks.
- Quaternary and Tertiary dune deposits, consisting of "**Kalahari red sands**", occupy the extreme northern part of the WMA bordering on Namibia. These dune deposits are of considerable thickness and comprise fine aeolian sands with occasional coarser gravel deposits.

The geohydrology is just as complex as the geology in the area but can be simplified to four main aquifers namely the Karoo sediments, the weathered granites and gneisses from the Basement complex, dolomites and associated formations and the primary aquifers such as the Kalahari sands and the alluvial deposits along streams and rivers and the coastal plains north of the Buffelsrivier. The first three of these aquifer types are typical dual porosity or secondary aquifers water associated with weathering and fracturing of the matrix. Typical yields and other characteristics for all aquifers are listed in Table 3. Primary aquifers are found in Kalahari sands and alluvial deposits associated with rivers and coastal plains.

Table 3 Yields and characteristics for major aquifer types in the WMA (Van Dyk, 2003)

Legend	Aquifer type	AverageYield (L/s)	Quality	Characteristics
G	Granites and gneisses	0.1 - 2	Poor quality (high SO_4 and F)	Lower rainfall areas. Stagnant systems, rich in dissolved salts from mineral dissolution
D	Dolomitic aquifers	0.5 - 5	Good quality	Higher rainfall regions, active systems, high pollution potential, shallow water levels
KB	Karoo Sediments - Beaufort	0.0 - 5	Good quality	Low to high yields, high pollution potential, shallow water levels
KDE	Karoo Sediments – Ecca and Dwyka	0.0 - 5	Poor quality (NaCl- rich)	Low to moderate yields rich in dissolved salts from mineral dissolution
P	Primary aquifers	0.0 - 5	Variable quality (mostly poor quality)	Complicated borehole construction

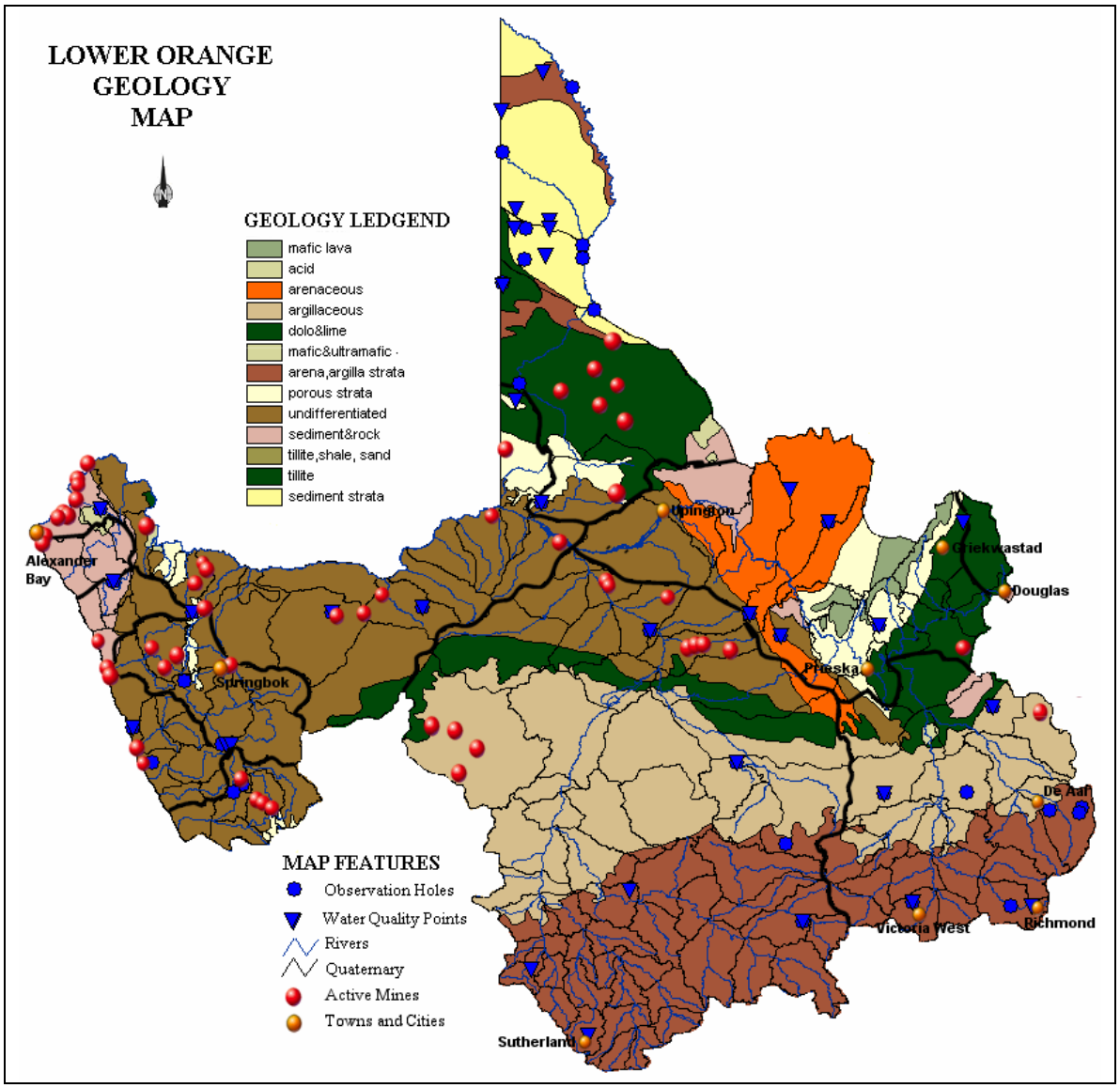

Figure 2 Simplified geology of the WMA

3 Riverbed Sand Aquifers

At small scale a number of these aquifers are utilized mostly along dry riverbeds, Buffelsriver, Saaipoort along Carnarvon leegte, along Gamagara river, Driekop Kanhardt. In the drier west almost all abstractions from boreholes associated with a proximate riverbed. Along the Orange River some abstraction along riverbeds is also taking place (Van Dyk, 2003). General characteristics of riverbed aquifers can be summarized as:

- Coarse gravels and sands are more typical of alluvial deposits. However, flood plains consist mainly of fine silt. Towards the end of a river's course, the river slows down dumping some of the heavier materials on these flood plains. Boreholes drilled into these types of formations normally have higher yields. It is important to note that borehole design is plays an important role in the yield of boreholes drilled into riverbed aquifers.
- 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 and 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.

4 Groundwater-Surface Water Linkage

Groundwater-surface water interaction has not been studied sufficiently in the Northern Cape due to the limited surface water. According to records documented by Van Tonder and Dennis (2003), under natural conditions there is seldom a connection between surface water and groundwater. However observed surface water recharge in normally dry riverbeds. Current quality problems experienced in the Vaal and Orange rivers, waterlogging experienced with irrigation along these riverbanks indicate interaction. Therefore a study is currently motivated by DWAF Geohydrology to investigate Groundwater-surface water interaction in the Vaal and Orange rivers (Van Dyk, 2003).

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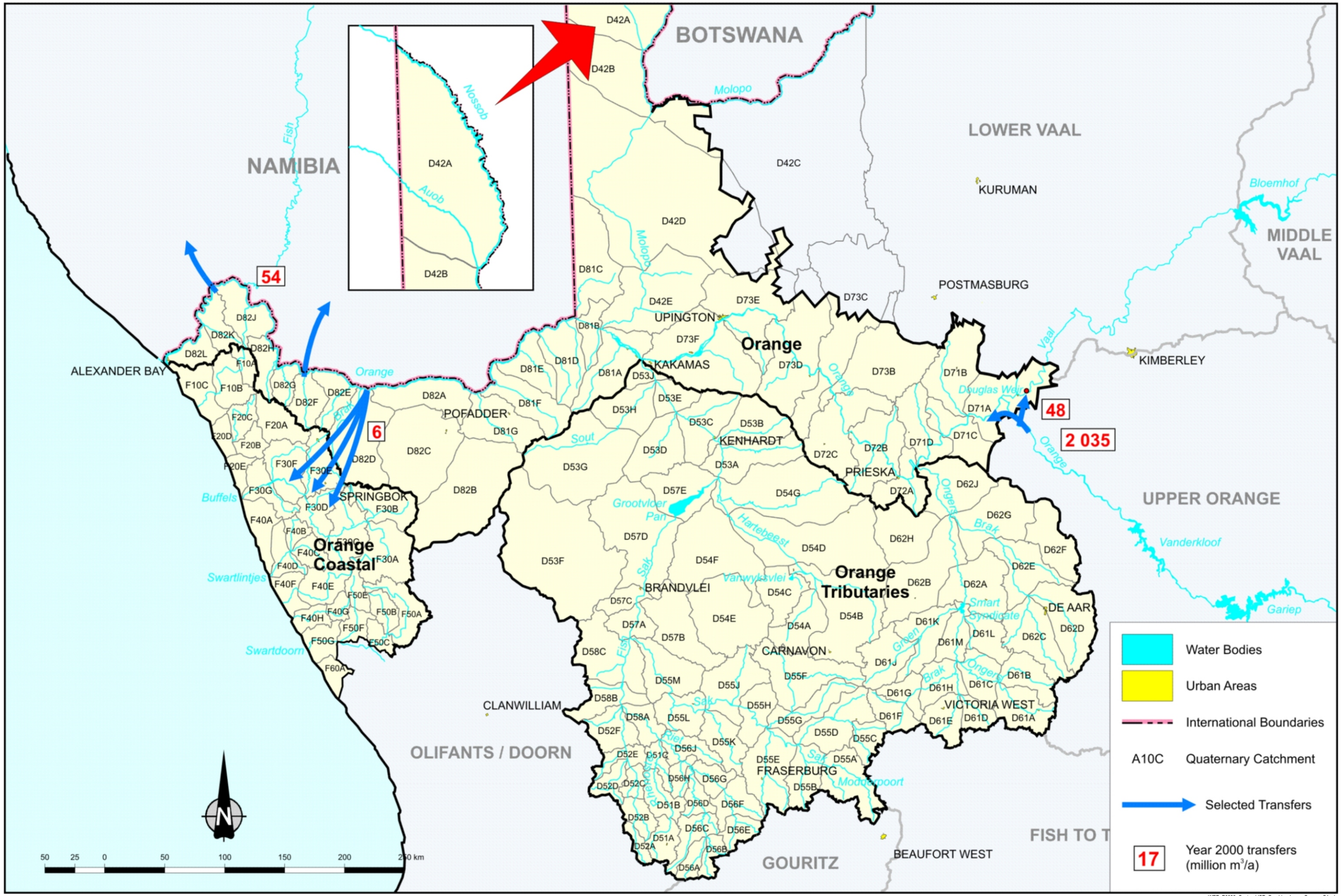
Appendix C

Figures

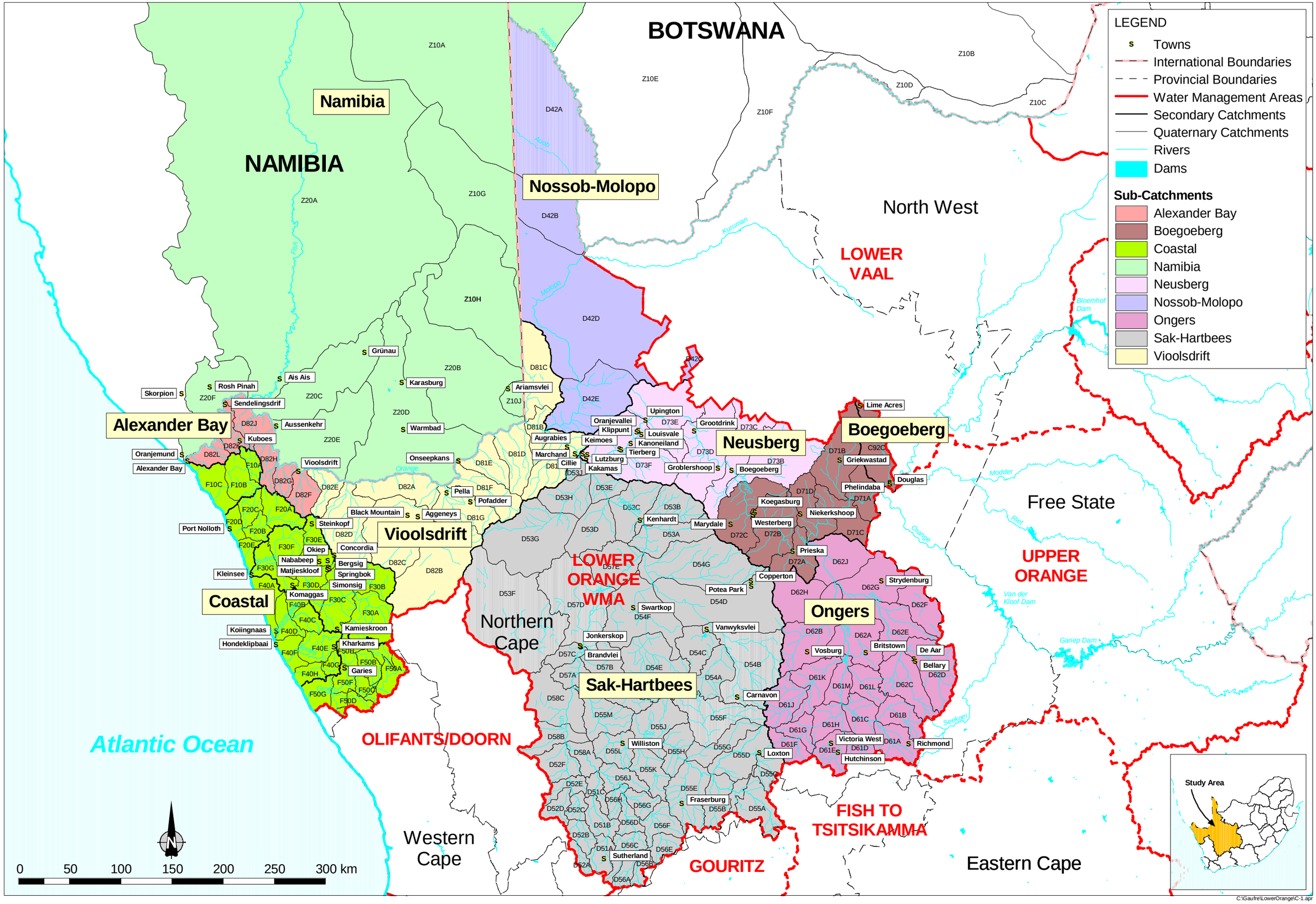


WRP_P0083_Centreal ISP_Graphics_Lower Orange_C1.cdr

ISP: LOWER ORANGE WMA

Lower Orange Transfers

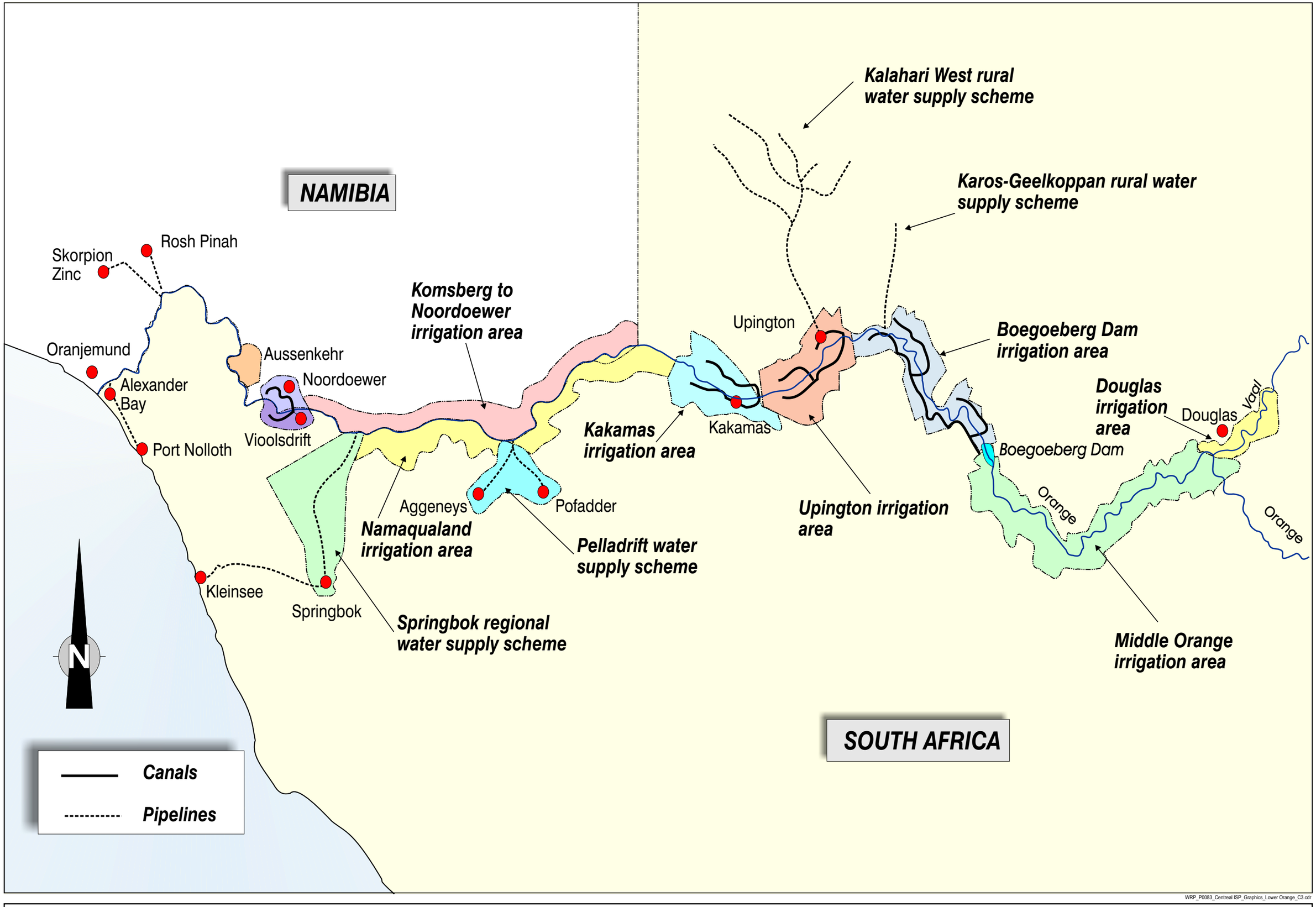
C 1



ISP : LOWER ORANGE WMA

Sub-Catchments

C 2



WRP_P0083_Centreal ISP_Graphics_Lower Orange_C3.cdr

Appendix D

Water Balances for Selected Areas Supplied from Local Resources

Table 1-1: Summary of key areas and towns with water resources

Name of town	Quaternary catchment	Key notes
ORANGE TRIBUTARIES SUB-AREA		
Ongers Sub-catchment		
Strydenburg	D62G	Groundwater as source. New abbatoir has been set up. Borefield will need to be expanded to meet the demand. **Deficit**
Vosburg	D62B	Groundwater as source **No Deficit**
Britstown	D62A	Close to a tributary of the Ongers. Groundwater as source. **No Deficit** but water borne sewage is being contemplated. This will stretch current supply system.
De Aar/ Bellary	D62D & C	Close to the Brak River Source. Groundwater is source. **No deficit**
Victoria West	D61E	Upper reaches of the Ongers. Groundwater is the source while Victoria West Dam is use to augment supply when it has water. **No Deficit** according to Regional Office.
Hutchinson	D61E	Upper reaches of the Ongers. Groundwater is source. **No Deficit** .according to Regional Office
Richmond	D61A	Upper reaches of the Ongers. Groundwater is source. **No Deficit** according to Regional Office
Sak-Hartbees Sub-catchment		
Kenhardt	D53C	Close to main Hartbees Town dam used for augmentation when water is available. Source is groundwater. **No Deficit**
Copperton / Proteapark	D54D	Water from Prieska on Orange main stem. **No Deficit**
Vanwyksvlei	D54B	Close to main Hartbees River. Source is groundwater. **Deficit**. The groundwater resources are being overexploited. New boreholes are being drilled and existing boreholes rehabilitated.
Carnarvon	D54B	Source is groundwater. **Deficit**. New boreholes are being drilled and equipped with pumps.
Loxton	D55D	Upper reaches of Sak River. Source is Loxton Dam & groundwater. **No Deficit** according to Regional Office.
Fraserburg	D55E	Upper reaches of Sak River. Source is Nuwe Dam & groundwater. Some groundwater quality problems but a treatment plant for H_2S are being constructed. **No Deficit** according to Regional Office.
Sutherland	D51A	Upper reaches of Sak River. Source is groundwater. A treatment plant has been constructed to deal with the water

Name of town	Quaternary catchment	Key notes
		quality problems associated with the groundwater. **No Deficit** according to Regional Office.
Williston	D55L	Upper reaches of Sak River. Source is groundwater. **No Deficit**
Brandvlei / Jonkerskop	D57C	Close to the main Sak River. Source is groundwater. **No Deficit** according to WSAM balance.
ORANGE SUB-AREA		
Boegoeberg Sub-catchment		
Lime Acres	C92C	Lower Vaal WMA
Griekwastad	D71B	Upper reaches of a small tributary of Orange. Groundwater is source. **No deficit**
Niekerkshoop	D71D	Groundwater is source **No deficit**
Douglas	D92C	From Orange River main stem. **No deficit**
Prieska	D72B	From Orange River main stem. **No deficit**
Westerberg / Koegasbrug	D72B	From Orange River main stem. **No deficit.** A mining town which has largely disappeared
Marydale	D72C	Groundwater is source. **No Deficit**
Neusberg Sub-catchment		
Groblershoop	D73D	From Orange River main stem**. No deficit.**
Upington	D73E	From Orange River main stem. **No deficit**
Louisvale / Oranjevallei / Klippunt	D73F	From Orange River main stem. **No deficit**
Kanoneiland	D73F	From Orange River main stem. **No deficit**
Keimoes / Tierberg	D73F	From Orange River main stem. **No deficit**
Eksteenskuil	D73F	From Orange River main stem. **No deficit**
Kakamas / Lutzburg / Cillie	D73F	From Orange River main stem. **No deficit**
Nossob-Molopo Sub-catchment		
Mier		Groundwater
Askham		Groundwater
Vioolsdrift Sub-catchment		
Augrabies	D81A	From Orange River main stem. **No deficit**
Marchand	D81A	From Orange River main stem. **No deficit**
Pella	D81G	From Orange River main stem (Pelladrift scheme) .. **No deficit**

Name of town	Quaternary catchment	Key notes
Pofadder	D81G	From Orange River main stem (Pelladrift scheme). . **No deficit**
Aggeneys	D82C	From Orange River main stem (Pelladrift scheme). **No deficit**
Black Mountain	D82C	From Orange River main stem (Pelladrift scheme). **No deficit**
Onseepkans	D81E	From Orange River main stem. **No deficit**
Concordia	D82D	From Orange River main stem (Springbok/Namakwa WB scheme). **No deficit**
Alexander Bay Sub-catchment		
Vioolsdrift	D82F	From Orange River main stem. **No deficit**
Kuboes	D82K	Orange River main stem **No deficit**
Alexander Bay	D82L	From Orange River main stem. **No deficit**
COASTAL SUB-AREA		
Port Nolloth	F20D	From Orange River main stem. (Pipeline from Alexander Bay system). Groundwater system is being rehabilitated. **No deficit**
Steinkopf	F30E	From Orange River main stem (Springbok/Namakwa WB scheme). **No deficit**
Nababeep	F30E	From Orange River main stem (Springbok/Namakwa WB scheme). **No deficit**
Okiep	F30E	From Orange River main stem (Springbok/Namakwa WB scheme). **No deficit**
Springbok / Bergsig / Matjieskloof / Simonsig	F30D	From Orange River main stem (Springbok/Namakwa WB scheme). **No deficit**
Kleinzee	F30G	From Orange River main stem (Springbok/Namakwa WB scheme). Augment from subsurface dam in Buffels River **No deficit**
Komaggas	F30G	Groundwater is source **No Deficit**
Koiingnaas (De Beers Mine)	F40D	Groundwater is source (Somnaasnoup aquifer). **No Deficit**
Kamieskroon	F30C	Groundwater is source **No deficit**
Hondeklipbaai	F40F	Groundwater is source. Supplied from Koiingnaas by District Council
Kharkams	F40E	Groundwater is source **No deficit**
Garies	F50F	Groundwater is source. **Deficit** as run out on occasions

Name of town	Quaternary catchment	Key notes
		due to poor management of borehole systems. There are two sources of water viz a fresh and brackish source. A management plan is being developed to manage the two systems optimally.

Appendix E

Principles and methods for the Implementing of the MIG

DRAFT VERSION 1

Suggested principles and methods for the implementation of the MIG (Municipality Infrastructure Grant) and proposing the future role of the DWAF.

BACKGROUND

Cabinet has approved the MIG on 5 March 2003 with the following conditions:

a) approves the establishment of the Municipality Infrastructure Grant (MIG) in the 2003/04 financial year:

b) approves that the following current conditions infrastructure grants should be phased out and consolidated into the MIG over the next three years.

1. The Consolidated Municipal Infrastructure Programme (CMIP) and Local Economic Development (LED) provisions, administered by the Department of Provincial and Local Government;
2. The Water Capital Grant, administered by the Department of Water Affairs and Forestry;
3. The Community Based Public Works Programme (CBPWP), administered by the Department of Public Works;
4. The National Electrification Programme (NEP), administered by the Department of Minerals and Energy; and
5. The Building for Sports and Recreation Programme, administered by the Department of Sports and Recreation;

c) agrees that the incorporation of poverty relief programmes into the MIG once there is greater clarity in respect of the distribution industry restructuring process;

d) agrees that the electricity grant would be incorporated into the MIG once there is greater clarity in respect of distribution industry restructuring process;

e) notes that the existing commitments of national departments administering current grants would be honoured;

f) approves that at least 92% of the grant be a formula-drive-three-year allocation process and that a maximum of eight percent be a separate window for a special Municipality Infrastructure Fund for regional investments and innovation;

g) notes that a formula and key policy proposals would be reviewed by the Cabinet through annual budget process, but that the Ministers of Finance and Provincial and Local Government may, if necessary, approve formula or policy changes;

h) notes that the Department of Provincial and Local Government will administer the MIG, subject to the oversight of the Municipal Infrastructure Task Team (MITT);

i) notes that national departments would be expected to exercise their normal responsibilities with regard to policy, strategic planning, regulation, monitoring can capacity building, while financial accountability (restricted to administering the transfer of grants) rests with the department of Provincial and Local Government;

j) requests the Director General of the department of Provincial and Local Government to constitute (and chair) the MITT, and request the Director General of the Departments of Water Affairs and Forestry, Minerals and Energy, Public Works, Sports and Recreation, Transport, Housing and the National Treasury to nominate their representatives to the MITT; and

k) requests the National Treasury and the Department of Provincial and Local to develop general monitoring systems for national oversight over municipalities. The system should address financial and non-financial performance elements and clarify the roles and responsibilities of all stakeholder national and provincial line-function departments.

PROBLEM STATEMENT

Now that the MIG is given, DWAF must ensure that all the " normal responsibilities with regard to policy, regulation, strategic planning, monitoring and capacity building" of a national department (as set out in sub-par (i) of the Cabinet decision) is still to be achieved through the MIG. It should be done in such a way as to minimise the concerns raised by DWAF in our meetings with NT as summarised by the DG in his memo reference 6/11/2003 of 21 February 2003 to the Minister.

SUGGESTED PRINCIPLES

1. That DWAF engage with municipalities at different stages of the project cycle. Although this would now essentially be a municipal process cycle, DWAF must engage in this process through what can be described as "entry points" or "gates". Some engagement can be described as "soft entry" points where we would support, interact and co-operate. Other points could be better described as "gates" or "hand entry points" where the conditions of the MIG must be met or else intervention or stoppage of funds should occur.
2. DWAF staff will not be transferred to DPLG or provinces but that DWAF staff engages in this monitoring and support role as a national department
3. The following soft entry points are proposed (see attached diagram):
   - Throughout the planning and WSDP process
   - During construction if resources allow
4. The following "hard entry points" or "check gates" are proposed:
   - Finalisation of the project priority list of council
   - Business Plan approval stage
   - Design stage
   - Completion of projects i.e. commissioning.
5. DPLG should do the general monitoring of the capital programme as per Cabinet decision (see (k) DWAF should provide a list of KPI's (Cabinet's "financial and non-financial

performance elements") to DPLG and National Treasury. This report must be presented on a monthly basis to DWAF and must enable DWAF to make an assessment at " check gates".

6. DWAF should as soon as possible review the conditions it want to impose on water supply and sanitation projects as these must be fed into the annual budget review process to ensure that it is printed in DoRA.

7. DWAF should at least achieve the following main goals through the above check gates, conditions and KPI's:

- Ensure that planning is done (WSDP as a legislative requirement)
- Basic needs are addressed. (engagement in WSDP and priority lists)
- Sanitation projects are prioritised (engagement in WSDP and priority lists.)
- Community involvement during all phase (e.g. concerns expresses by chair of portfolio committee on CMIP sanitation projects)
- Funding and provision for operation and maintenance. (and designs and construction can promote that)
- Soft issues such as awareness, health and hygiene are all included. (in BP as well as during implementation)
- Construction is labour based. (determined at BP and design stages)
- Sustainability in all its many elements is achieved. (such as institutional arrangements with a WSP)
- Projects are not merely consultant driven but bases on real needs within communities.

GOVERNANCE PRINCIPLES

As agreed between DG's there would be two levels of the MITT (Municipal Infrastructure Task Team), the first at DG or DDG level and the second at operational level.

The DG/DDG committee should deal with

- Strategic issues such as refinement of policy and implementation strategy.
- Formula issues and oversight over allocation to municipalities
- Review regular reports from operational committee and can request independent audits.
- Deal with those cases where conditions of the MIG will result in funds being withhold or withdrawn.
- Deal with appeal cases from local government.

The operational committee should do the following:

- Ensure implementation.

- Review and correct blockages in process.
- Review regular reports from municipalities and PMU's.
- Recommend policy changes to the DG/Higher Committee.

Helgard Muller

CD: WS