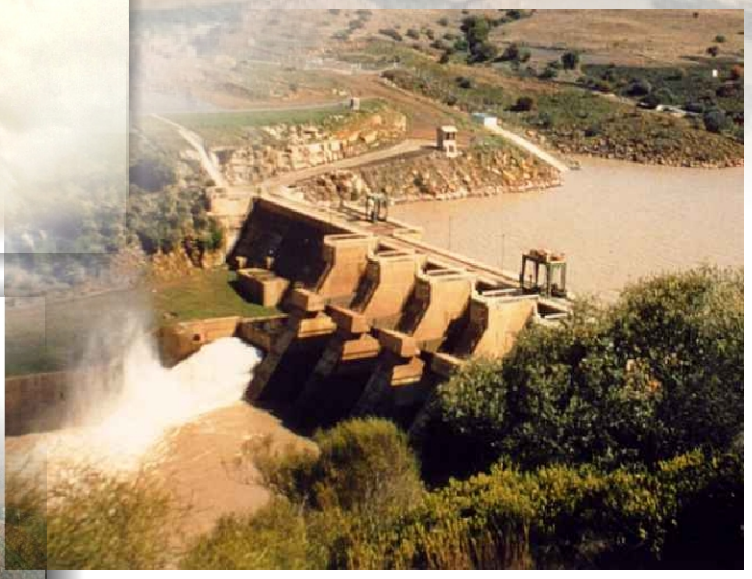
Report Number: P WMA 14/000/00/0304

**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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WRP_FC415

Department of Water Affairs and Forestry
Directorate National Water Resource Planning

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

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| ***Title:*** | *Internal Strategic Perspective for the Lower Orange Water Management Area* |
| ***DWAF Report No:*** | *P WMA 14/000/00/0304* |
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***Approved for Consultants by:***

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*Project Leader*

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*Deputy Project Leader*

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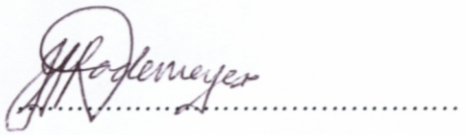
*DEPARTMENT OF WATER AFFAIRS AND FORESTRY*
*Directorate National Water Resource Planning*
***Approved for the Department of Water Affairs and Forestry by:***



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## REFERENCE

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### INVITATION TO COMMENT

This report will be updated on a regular basis until it is eventually superseded by the Catchment Management Strategy.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

### ELECTRONIC VERSION

This report is also available in electronic format as follows:

- DWAF website:
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  - Internet: http:/www.dwaf.gov.za/documents/
- On CD which can be obtained from DWAF Map Office at:
  157 Schoeman Street, Pretoria (Emanzini Building)
  +27 12 336 7813
  MAILTO:APM@DWAF.GOV.ZA

  or from the Version Controller (see box overleaf)

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

- Internal Strategic Perspective Lower Orange WMA (*this report*) (Report No: P WMA 14/000/00/0304)
- The National Water Resource Strategy, First Edition 2004
- The Lower Orange WMA - Overview of Water Resources: Availability and Utilisation (Report No: P WMA 14/000/00/0203)
- The Lower Orange WMA – Water Resources Situation Assessment (Report No: P WMA 14/000/00/0101 )
- Internal Strategic Perspective for the Orange River System: Overarching (Report No: P RSA D000/00/0104 )

| LATEST VERSION |
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| VERSION CONTROL | |
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| The most significant amendments included in the latest version will be indicated here. | |

# *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. |