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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

# Groundwater

**The Reserve is that part of Resource Directed Measures which specifically refers to the quantity and quality of water (mainly surface water) required for meeting basic human needs and those of aquatic ecosystems, before any other uses of water from the resource are permitted. Wherever groundwater plays a role in sustaining the Reserve, the Groundwater component of the Resource Directed Measures needs to be an integral part of the Reserve determination process.**

## Setting Resource Directed Measures for Groundwater

### Balancing use and protection

The National Water Act (NWA) aims to ensure access to and use of the limited resource, water, on an equitable basis in an integrated, managed and sustainable manner, giving priority to basic human needs and needs to sustain the aquatic environment. Legal decision-making tools for attaining a balance between protecting and using water resources include:

- Classification systems for water resources;
- The Reserve; and
- Resource Quality Objectives (RQOs).

The term Resource Directed Measures (RDM) implies application of all three of the above-mentioned tools and is one of the key strategies adopted by the Department of Water Affairs and Forestry (DWAF) to implement the National Water Act.

> The Reserve is that part of RDM that specifically refers to the quantity and quality of water (primarily surface water) required for meeting basic human needs and those of aquatic ecosystems before any other uses of water from the resource are permitted.

**Groundwater, unlike surface water, and because of its unique characteristics such as wide geographical extent and slow rate of movement, is not afforded sufficient protection under the Reserve, particularly in those areas where the groundwater resource has no apparent link to surface water**.

Even where a link does exist, the Reserve only addresses the role groundwater plays in meeting basic human needs and sustaining aquatic ecosystems such as rivers and wetlands. Addressing the use and protection of the entire groundwater resource holistically, requires that RDM for groundwater (or alternatively stated, the **Groundwater component of RDM** (known as GRDM) be applied in its entirety. In reality, Classification and RQOs are the components of GRDM that are essential to ensuring the sustainable use of groundwater, as dictated by the NWA.

The NWA states that the Minister must determine the Reserve for all or part of every significant water resource. Where there is interdependence between such a resource and groundwater, it is imperative that groundwater be taken into consideration, otherwise excessive abstraction and consequent lowering of the water table might cause groundwater discharge to surface water bodies to diminish or cease altogether. Thus, wherever groundwater plays a role in sustaining the Reserve, GRDM needs to be an integral part of the Reserve determination process.

### GRDM Manual, Software and Pilot Study

The focus hereafter is on GRDM tools that have been researched, developed and subsequently captured for general use in the resulting GRDM Manual and supporting software.

The application of the GRDM tools has been demonstrated in a documented pilot study undertaken for the E10 Catchment (Western Cape Province), covering an area of some 2 900 km$^2$ and drained primarily by the Olifants River.

## GRDM Assessment

### Assumptions

Assumptions made to be able to undertake GRDM assessments and quantify the volume of groundwater required to meet Classification requirements and sustain the Reserve, include:

- Groundwater systems are generally resilient and can normally recover from most perturbations, the exception being groundwater contamination that can persist over decades and centuries.
- Groundwater resources can be developed and used to some point, without significantly impacting the ability of groundwater resources to sustain the Reserve or meet the RQOs.
- This non-occurrence of significant impact is reflected in regional groundwater levels not declining significantly over the long term and ambient groundwater quality remaining within natural limits.
- The sustainable rate at which groundwater can be abstracted is a function of the average long-term annual recharge.
- The GRDM assessment will be carried out by persons qualified and experienced in the field of groundwater hydrology who, in turn, will collaborate with other specialist hydrologists and ecologists.
- The GRDM assessment will be subject to formal review.

### Steps

Only those technical components that have to be addressed by the groundwater specialist of the broader RDM project team are mentioned here, and detailed in the GRDM manual. Sequential steps in setting the GRDM are the following:

***Preparatory Phase***: The preparatory phase is undertaken by DWAF's RDM Scoping Team, which includes a hydrologist, geohydrologist and ecologist. The multiple purpose of this phase is to initiate a GRDM study as part of a broader RDM/Reserve assessment, set the level of GRDM assessment required and appoint a GRDM assessment project team.

***Description of study area***: The study area is described in terms of its physical and geohydrological characteristics, in sufficient detail appropriate to the level of GRDM assessment required. In this and all subsequent steps, tasks are the responsibility of the project geohydrologist, who obtains inputs from other specialists, as required.

***Delineation of units***: Groundwater resource units are delineated based on quaternary catchment boundaries, aquifer type (primary aquifer, secondary aquifer, dolomitic aquifer) and other physical, management and/or functional criteria.

***Resource classification***: The present status category and water resource category of each groundwater resource unit are defined using the prescribed categorisation system, the output of which will feed into processes (including catchment visioning and the involvement of stakeholders) for setting desired management classes for significant water resources.

***Quantifying the Reserve***: The volume of groundwater that can be abstracted from a groundwater unit without impacting the ability of the groundwater system to contribute to the Reserve (basic human needs, ecological requirements) is quantified.

***Resource Quality Objectives:*** Based on the conceptual understanding of the area, RQOs are set for each resource unit to guide management and monitoring activities. This is done by selecting key measurable indicators (e.g. water levels, total dissolved solids, faecal coliforms, etc) as RQOs and the level at which they should be maintained (natural, slightly modified, etc.).

### Review

Each assessment of the groundwater allocation of a significant water resource should be reviewed by a panel of

experts prior to setting the Reserve. This will assist in overcoming any data shortage problems by providing for expert judgement. It will also allow for checking and standardisation of GRDM assessments and for linkages of groundwater to other components of the hydrological system, as well as the validity of the set RQOs, to be considered.

### Levels

Four levels of GRDM assessment are recognised – desktop, rapid, intermediate and comprehensive – with each higher level providing an increased level of confidence. Increased levels of commitment and resources are required to attain higher levels of confidence.

Desktop GRDM assessments can be completed in a matter of hours, but comprehensive GRDM assessments may take over a year to complete. The same level of assessment need not be applied across a study area; a multilevel GRDM assessment approach may be adopted.

Rapid level assessments could suffice in low usage areas, in low stress areas or in instances where usage is expected to have limited impact. Assessments that are more detailed may be undertaken in areas where specific problems occur or in areas where the underlying groundwater system is clearly stressed. Scoping studies can be undertaken prior to commissioning GRDM assessments to identify those 'significant' water resources in a study area that require higher levels of assessment.

## Post GRDM activities

Setting RQOs marks the completion of the technically driven components of the GRDM process. However, the process is not only technically based. It must also consider social, economic, efficiency and other factors.

Because of this, the process has to be iterative to allow for consideration of the outcome of the catchment visioning process and linkages to other components of the hydrological cycle that may have emerged during the GRDM assessment.

In addition, once the RDM assessment is in place, monitoring requirements and the allocation of the water resource have to be considered. **It is crucial that specialists are aware of management activities relating to the implementation and enforcement of RDM in general and GRDM in particular**.

These include:

- ***Implementing RQOs***: Giving effect to the RQOs includes the catchment visioning process and publishing the Reserve for public review and comment.
- ***GRDM-driven monitoring and auditing***: Monitoring essentially falls outside the GRDM assessment process, but is required to ensure that the Reserve and Resource Quality Objectives are both realistic and are adhered to. Information obtained from post-GRDM assessment monitoring will be used in the review of the assessment (usually within a period of five years).
- ***Allocation***: A GRDM assessment, in aiming to determine the amount of groundwater that can theoretically be abstracted without impacting the ability of the resource to support the Reserve, is but at the start of the water resource management process. While apportionment or allocation of water to individual users or applicants lies outside the scope of GRDM assessment and is not addressed in the GRDM manual, sight should not be lost of the fact that such allocation is an ultimate goal and important driver of the GRDM assessment process.

### Methods, tools and data

While undertaking a GRDM assessment requires a degree of experience and expert knowledge, new tools and methods are constantly being developed to assist in addressing the challenges of the task. It remains the responsibility of the geohydrologist undertaking a GRDM assessment to select and use appropriate tools, methods and supportive software packages.

For convenience, the GRDM manual incorporates a detailed description of tools and methods that can be used to quantify various components of GRDM. These include alternative methods for calculating or obtaining components of the resource water balance and procedures for deriving quantities needed for setting RQOs.

## Challenges ahead

***Data***

Unlike surface water, the groundwater sector is data-poor, which makes it almost impossible to quantify all the parameters required in a GRDM assessment with a high degree of confidence. A proposed different approach to GRDM promises, at least partially, to overcome this paucity of data.

***Monitoring***

Guidelines, required by both water resource managers and practitioners, regarding GRDM-driven monitoring and how it should fit into the broader process of groundwater monitoring in South Africa, need to be developed.

***Integration***

The integration of groundwater into the RDM procedure is required by law. Pro-active steps to achieve this ideal in practice need to be taken.

***Methodologies***

Methods for GRDM assessments are still under development and review. It may be years before the methods are sufficiently improved and attain complete and unequivocal acceptance.

***Definitions***

The term 'significant water resource' is in need of a legal definition. The current interpretation is that 'significant' refers to the spatial extent of a resource and not to its importance.

**For more information**:

To obtain the WRC research report and GRDM manual (Report No **TT 299/07**), contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565 or E-mail: orders@wrc.org.za
The GRDM software is periodically updated. To access the latest version, visit: www.usersupport.co.za or contact the User Support Group at Tel: (012) 336-7090.