Groundwater plays a pivotal role in the socio-economic development of Zimbabwe as up to 70% of the rural population relies on groundwater for a secure and safe drinking water supply. Increasing water demand due to the expanding urban and rural populations and the industrial, mining and agricultural sectors requires proper assessment, planning, development and management of groundwater resources in Zimbabwe to avoid over-exploitation and degradation of its quality.

It is within this context that new regulations and guidelines were developed for drilling and construction of boreholes, groundwater monitoring and groundwater use. The formulation of these regulations and guidelines formed part of an on-going ‘Water Sector Reform’ programme that was initiated by the government in 1993.

The groundwater regulations and guidelines aim at ensuring that all groundwater development procedures are undertaken consistently within a framework of integrated water resources management and providing a basis for standardised data collection and reporting procedures. Key issues of the groundwater regulations and guidelines discussed in this paper are (1) authorisation for borehole drilling and (2) the permitting system for groundwater use.

1. INTRODUCTION

Groundwater in Zimbabwe forms the main source of drinking water in rural areas where about 70% of the population lives. The total annual abstraction of groundwater in these areas, from ~40,000 boreholes, is estimated at 35 x 10^6 m^3 and the total groundwater abstraction for the agricultural sector is estimated at 350 x 10^6 m^3. Groundwater is also abstracted for emerging towns known as Growth Points (e.g. Gokwe), Urban Centres (e.g. Bulawayo) and Rural Institutions (e.g. schools, health and business centres). Overall, groundwater presently contributes not more than 10% to the total water use in Zimbabwe. More groundwater exploration and exploitation is needed to secure future development of the rural areas and urban centres though the extent of development will be constrained by the availability and quality of groundwater.

New groundwater regulations and guidelines were developed for Zimbabwe in 1999 to control groundwater development and management. The regulations and guidelines compliment the new Water Act (1998) and have been formulated within a framework of integrated water resources management (IWRM). Implementation of the regulations will be carried out by a fully restructured water sector (Section 1.3).

1.1 Integrated Water Resources Management (IWRM)

Groundwater exploitation should be viewed as part of water resources management (WRM) in which social, economical, legal and institutional issues are integrated. Key elements that are
generally referred to in WRM are *assessment, planning, development and management* (Tuinhof, 1994; see Fig. 1):

- **Assessment** is considered the basis for planning, development and management and includes quantitative and qualitative descriptions of water resources and water demands.
- **Planning** of groundwater resources aims at matching water supply and water demand and is based on the integration of multi-disciplinary findings. It results in integrated plans of activities for different time scales.
- **Development** of groundwater resources is based on the results of the planning phase of a WRM process and comprises the design, tendering and implementation of groundwater related projects such as e.g. drilling of boreholes and construction of a well field.
- **Management** of groundwater resources deals with the operation and maintenance of water supply systems and the quality of water supply, (preferably) in a sustainable manner.

![Fig. 1: Integrated Water Resources Management (Tuinhof, 1994)](image)

### 1.2 Groundwater resources in Zimbabwe

Groundwater in Zimbabwe mainly occurs within crystalline rocks that cover most of the country’s area (~66%; see Fig. 2). Although the groundwater development potential of these rocks is generally low they form the main source of drinking water for the rural population. Groundwater abstraction for the agricultural sector is mainly from (consolidated) sedimentary aquifers: Lomagundi Dolomite and Nyamandhlovu Forest Sandstone and from (partly consolidated) alluvial aquifers: Save Alluvial Aquifer.
1.3 Reform of the Water Sector

The assessment, planning, development and management of all water resources in Zimbabwe is a government mandate executed by the Department of Water Development (DWD) in the Ministry of Rural Resources and Water Development. The government, after realising the need for improved water resources planning and management to meet the increasing water demand, initiated a comprehensive water sector reform programme in 1993 with the support of the donor community. A parastatal: Zimbabwe National Water Authority (ZINWA) was formed to take over most of the responsibilities of the DWD and manage water resources on a river catchment basis. Policy formulation and regulatory functions will remain the responsibilities of the new DWD. The first phase saw the enactment of a new Water Act and ZINWA Act in 1998 after a thorough stakeholder involvement and consultation. Seven catchments have been defined (Fig. 2) and will be manned by Catchment Councils (CCs) responsible for granting permits and implementing water resources management decisions. Sub-Catchment Councils (SCCs) are the lowest official tier and will regulate and supervise the exercise of rights to water within their areas.

The implementation of the ZINWA and Water Acts is supported by various regulations and guidelines, some of which have already been adopted by the Ministry and with others still to be finalised and gazetted. Groundwater use, except for primary purposes, will require a permit just as will surface water abstraction and surface water storage.

The increasing water demand in Zimbabwe requires proper planning, development and management of water resources to ensure sustainable and efficient use and equity of access and sharing of resources. Within this context new groundwater regulations and guidelines were developed for borehole drilling and construction, groundwater use, monitoring and reporting. The regulations and guidelines will assist groundwater developers and end users, as there will be a standardised basis for groundwater development and use. They form crucial components of integrated water resources management at catchment and sub-catchment level in Zimbabwe, as they will assist the CCs in formulating and implementing water resources management strategies.
2. ZIMBABWE GROUNDWATER REGULATIONS AND GUIDELINES

Minimum requirements and standards for each component of the IWRM concept have been developed so as to ensure that the development of groundwater does not compromise its quality and quantity.

2.1 Groundwater Resource Assessment

This phase focuses on the assessment of quantitative and qualitative aspects of groundwater resources and water demand. Borehole siting is considered an important activity in the preliminary stages of identifying groundwater resources. Some of the following criteria have to be considered during the assessment phase:

i) minimising the pollution risk: boreholes have to be drilled away from potential sources of pollution such as pit latrines, animal kraals, dip tanks, grave yards, etc

ii) interference between boreholes has to be minimised by appropriate positioning

A water source inventory or hydrocensus, remote sensing, geophysical survey, geological and hydrogeological appraisals shall be carried out as part of borehole siting. Boreholes to be used for commercial purposes will require a hydrogeological appraisal from qualified personnel before they are developed.

2.2 Groundwater Resource Planning

Groundwater resource planning focuses on the selection of the most viable options for meeting the water demands. Catchment Councils in conjunction with ZINWA will produce Catchment Outline Plans (COPs) detailing water requirements and strategies to meet them. It is envisaged that the COPs should cover a period of twenty years so as to conform to the permit duration.

2.3 Groundwater Resource Development

This phase mostly involves the construction of boreholes for groundwater abstraction. Down the hole, mud rotary and cable tool are the commonly used drilling techniques. Boreholes shall be partially or fully lined with casing and slotted casing or screens as determined by the prevailing hydrogeological conditions. A sanitary seal shall be constructed to a depth of 5 m. Borehole development and rehabilitation methods would either be mechanical or chemical. Mechanical methods would involve air lifting, air and water jetting, block surging and hydrofracturing and the chemical method would be polyphosphate or acidification. Chlorine yielding compounds are recommended for borehole disinfection. Dry or abandoned boreholes have to be backfilled and plugged. Drilling sites are to be cleaned of waste material, debris and oil spills and the mud pits neutralised and backfilled to avoid contamination of the groundwater.

Observation boreholes shall be drilled, if deemed necessary by the CC, for observing water level changes and or collection of water samples for water quality monitoring. The positioning of the boreholes is crucial in obtaining representative information and shall be done by qualified personnel.

Routine pumping tests (step drawdown, constant discharge rate and recovery) shall be carried out on boreholes to be used for commercial purposes to determine their efficiencies, sustainable yields and aquifer properties. These parameters will be used in designing management strategies. Pumping equipment, recommended in the groundwater guidelines, shall be installed and the pumping durations adhered to so as to avoid over-abstraction and possibly the deterioration of the groundwater quality.
Each borehole will be allocated a unique number for ease of reference and database management. Owners of commercial boreholes shall equip them with flow meters to measure abstraction and piezometers for water level observation.

2.4 Groundwater Resource Management

Groundwater resource management requires the collection and analysis of data. Groundwater monitoring, data collection and reporting shall be carried out by the owners of the boreholes. ZINWA will carry out data evaluation and analysis and recommend management strategies. Monthly abstraction and water level data shall be submitted to the CC every 3 months. Water quality data shall be submitted to the CC every 3 years or as otherwise specified by the CC. The CC may enter any property to ensure compliance with the requirements. Data collection and reporting should include information on borehole siting, drilling and construction, pumping test, equipping and monitoring and shall be submitted to the CC in the prescribed forms.

2.4.1 Authority for borehole drilling

A control on borehole drilling and groundwater use by the CC is necessary in order to ensure effective and efficient water use. It has the added advantages of i) ensuring transparency on water allocation and use ii) it minimises uncontrolled groundwater abstraction and iii) it will ensure the provision of the much needed hydrogeological information for sustainable management of groundwater quality and quantity.

Every borehole (except for primary use) can be drilled only after obtaining the CC’s Authority. The authority will lapse after twelve months. Flow Chart 1 outlines the steps involved in applying for an authority to drill a borehole(s). Information such as property name, location of existing boreholes, the number and location of potential sites to be drilled, water use and abstraction volumes shall be submitted to the CC’s on prescribed forms whether or not the borehole is to be used for primary or commercial purposes. It is also mandatory to submit the drilling and construction, pumping test, pump installation and water quality data to the CC on the appropriate forms provided by the CC.

Flow Chart 1: Application for authority to drill

```
Yes
Water for primary use?

No

Contact CC

Apply for Authority to drill

Authority approved?

YES
Authorisation and submission of information

NO

Adequate resources?

YES

No permit required, but submission of borehole data

NO

Flow Chart 1: Application for authority to drill
```
2.4.2 Permit for groundwater use

Permitting will prevent abuse of groundwater resources. No groundwater shall be abstracted, other than for primary purposes, without a permit issued by the CC. A CC may issue a temporary, general or specific permit if all the requirements are met. Temporary permits shall cover existing groundwater users or those requiring excess seasonal water. Flow Chart 2 gives the steps involved in applying for an abstraction permit. Granting of an abstraction permit by the CC will take into consideration the existing surface water permits or applications and the availability of both groundwater and surface water.

Flow Chart 2: Application for abstraction permit

Information on existing permits, type and capacity of pumping equipment, etc., has to accompany the application form. Specific forms have been developed to provide the required information. A CC shall notify persons that may be affected before granting a permit. Any objectors to the abstraction application may inform the CC within 21 days in writing and shall provide their particulars and the reasons for the objection.

The abstraction figure for a general permit is based on the natural regions of Zimbabwe (linked to average annual rainfall; Table 1), property size and a conservative 2% average annual rainfall as potential recharge (figure will be refined as more information is gathered). Table 1 gives the upper limits of abstraction for a general permit for the various property sizes and rainfall conditions. A specific permit may be granted if the abstraction is greater than that of a general permit. A specific permit application shall be accompanied by a detailed hydrogeological report. The permit duration will be determined by the CC but is generally around 20 years. An abstraction measuring device and a provision for water level monitoring shall be installed on the borehole. Abstraction and water levels shall be recorded monthly and the data submitted to the CC every 3 months.

The CC may re-allocate an unused portion of the permit or suspend or reduce abstraction during droughts. The permits must be renewed on expiry. Permit review will be instituted where there is a violation of permit conditions, deterioration of the water quality, non-use for 3 years or at the request of the permit holder. The review could constitute changing the abstraction volume, altering the permit classification and charge, cancellation or suspension. The CC will enforce permit compliance. Contravention constitutes an offence and the appropriate fine will be charged.
Any aggrieved person has the right to appeal to the Administrative Court.

**Table 1: Upper limits of groundwater abstraction for general permit**

<table>
<thead>
<tr>
<th>Property size (ha)</th>
<th>Average Rainfall (mm/yr)</th>
<th>Upper limit abstraction (m³/yr/ha)</th>
<th>Zimbabwe Natural Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>1000 - 800</td>
<td>200</td>
<td>I</td>
</tr>
<tr>
<td>10 – 30</td>
<td>6000 - 6500</td>
<td>600</td>
<td>II</td>
</tr>
<tr>
<td>30 – 37.5</td>
<td>6000 - 7500</td>
<td>600</td>
<td>III</td>
</tr>
<tr>
<td>37.5 – 45</td>
<td>7500 - 9000</td>
<td>600</td>
<td>IV</td>
</tr>
<tr>
<td>45 – 65</td>
<td>9000 - 13000</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>65 – 85</td>
<td>13000 - 17000</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>85-100</td>
<td>17000 - 20000</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>&gt;1000</td>
<td>200000</td>
<td>600</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abstraction (m³/yr)</th>
<th>Primary use</th>
<th>Primary use</th>
<th>Primary use</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
</tr>
<tr>
<td>16000</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
</tr>
<tr>
<td>130000</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
</tr>
<tr>
<td>1000000</td>
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<tr>
<td>&gt;1000000</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
<td>6000 - 6500</td>
</tr>
</tbody>
</table>

3. IMPLEMENTATION OF GROUNDWATER REGULATIONS

Implementation of the regulations shall be within 3 years from the date they come into effect. Existing groundwater users may be granted temporary permits and shall monitor abstractions and water levels on a monthly basis or as specified by the CC. New commercial boreholes will require authorisation for drilling and application for an abstraction permit. All the required specific forms have to be completed and submitted to the CC.

After the 3 year period, the CC may grant temporary permit holders general or specific permits. Permit holders shall submit abstraction, water level and water quality data to the CC within the stipulated periods.

4. ACKNOWLEDGEMENTS

We would like to acknowledge E. Martinelli and Associates who drafted the first version of the Zimbabwe groundwater regulations and guidelines in consultation with various stakeholders from the water sector in 1999. The GTZ-RWS project in particular is thanked for their advice and financial support to the development of these regulations and guidelines.

5. REFERENCES

Government of Zimbabwe. Natural Regions and Farming Areas Map of Zimbabwe; scale 1:1,000,000, 1983.