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PEOPLE AND SYSTEMS FOR WATER, SANITATION AND HEALTH

Effective monitoring systems for sustainable rural groundwater supply

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A THREE-YEAR research project in groundwater is currently being carried out in rural villages of three provinces in South Africa with the support of the Department of Water Affairs and Forestry (DWAF) and the Norwegian funding agency NORAD.

This paper covers the latest findings from the field studies that are being carried out, both in terms of groundwater monitoring methodologies and also institutional frameworks. It also makes recommendations for effective groundwater monitoring. Two groups of villages were identified, villages responsible for running and maintaining their own water supply scheme and villages that are operated and maintained by the District Municipality. Boreholes in the former villages were driven by diesel engine and the latter are electrically driven. Problems encountered at village level are borehole infrastructure for taking water level readings and collecting water samples; payments for water supply, diesel and pump attendant salary; low level of education. Due to the lack of clarity in the roles of staff within the District Municipality difficulties in setting up communication channels were experienced. A GIS monitoring database is still under construction.

Introduction

Groundwater plays a valuable role in meeting water demand in rural settings. In rural areas, where only limited surface water supplies are available for villages or surface water supplies are situated a long way away, groundwater can play a critical role in meeting domestic water requirements. This project focuses on sustainable development of groundwater sources under the community water supply and sanitation programme. One of the project objectives is to assess the current methods in place for groundwater monitoring purposes. Not only are the physical infrastructures (such as water level measuring access tubes, flow meters, dip meters and log books) being reviewed, and emplaced if necessary, social and governmental structures are also being reviewed. Comprehensive guidelines will be drawn from the field-based research for the effective monitoring of rural groundwater supplies.

One of the pilot study sites is the Chris Hani Municipal District in the Eastern Cape Province of South Africa (Figure1).

In villages that were selected as pilot study sites groundwater resources are currently being monitored. This is carried out by obtaining data on groundwater levels to determine whether groundwater is being abstracted at a sustainable rate. This process also involves collection, transfer and analysis of groundwater data and implementation of groundwater management recommendations made by the hydrogeologist.

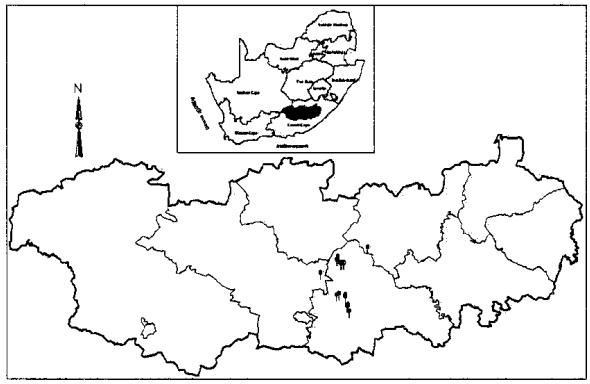

Figure 1. Location of the of Chris Hani District Municipality and monitoring boreholes

All these are done at different levels within the monitoring system i.e. from the pump attendant up to the government authorities and water service institutions.

Proper training of people involved in each level is essential.

Methodology

The criterion that was used to select monitoring boreholes was based upon communities with groundwater resources that are vulnerable to over utilization (DWAF, 2000). Selection of these villages and boreholes was done in consultation with the Health Department at Chris Hani District Municipality.

The Chris Hani District Municipality has two groups of villages:

firstly there are villages that are responsible for running and maintaining their own water supply scheme (independent) and, secondly, there are villages that are operated and maintained by the District Municipality (dependent). Field visits were carried out in both independent and dependent villages by hydrogeologists. These were carried out to determine the status of existing boreholes and other water supply infrastructure in and around each village and to identify required infrastructure for the boreholes in each village. In the independent villages, community workers accompanied the hydrogeologist so as to facilitate the community's involvement in the process. A dialogue was established with the community members through their Water Service Committee. In the dependant

villages an employee from the Engineering Department at the District Municipality responsible for the maintenance of the boreholes accompanied the hydrogeologist. Requests were made for installation of infrastructure in boreholes that were not equipped for monitoring. The infrastructure included: conduit piping for taking water levels by means of a dip meter; flow meters for measuring borehole abstraction; a "take-off" pipe to determine the yield of the borehole and for collecting water samples.

Pump attendants were trained to take groundwater level measurements (using a dip meter), groundwater abstraction readings (from a flow meter) and pumping duration. All measurements are recoded in a logbook.

Before the data were sent to relevant authorities for capture and analysis, communication channels from the village level to local government were established. The proposed flow of information is shown in Figure 2. After the communication channels are established, a geographic information system (GIS) that complies with existing GIS databases at regional level will be developed. This will be done by using an existing GIS database from DWAF and data required for monitoring purposes will be added. Data relevant for the monitoring process are groundwater quality and depths, and rainfall. The data are recorded in logbooks, captured and analyzed using the GIS, Arcview. Some of the data that can be used in the database are village location, roads, population, rivers, and dams. Staff at appropriate regional level will be trained in operating and managing the system. A hydrogeologist from DWAF or an external consultancy will be trained in using the GIS so as to give recommendations should problems occur with a borehole or water supply scheme.

In addition to groundwater levels, groundwater quality will also be monitored to provide data on the potability of the groundwater and to ensure that the resource is being adequately protected.

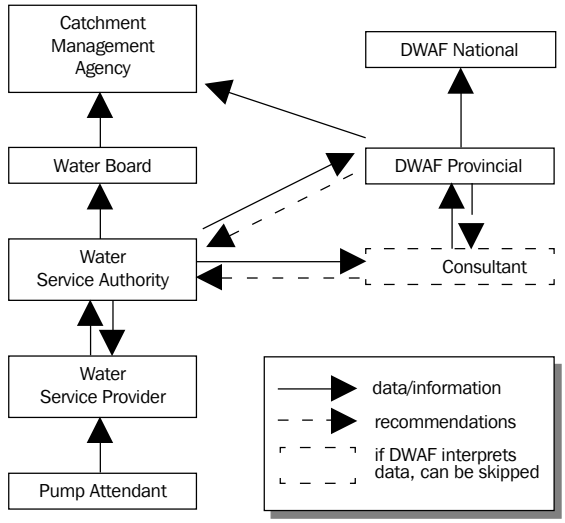

Figure 2. Proposed flow of information (Murray, 1998)

Results and discussion

Borehole pumps in the independent villages are all driven by diesel engines and those in the dependant villages are electrically driven. Most of the boreholes in both dependant and independent villages were not well equipped and not easily accessible for taking water level readings or for collecting water samples.

In the independent villages members were delegated by the community and trained in all aspects of operation and maintenance of the infrastructure upon completion of the scheme. These members are called pump attendants. The pump attendants are responsible for operation and maintenance of the borehole pumps. Figure 3 shows the water levels after pumping in one of the monitoring boreholes in the independent villages. This borehole is pumped at least once a week for about 12 hours. The water level in this observation borehole has declined by at least two meters. In this case, the pumping rates can be reduced to avoid over pumping of this borehole.

One of the problems encountered in the independent villages is the payment for the water supply, diesel and pump attendant salary. Data collected in some of the independent villages were recorded correctly but in other villages were not accurately recorded.

Field visits to these villages helped in identifying key training requirements and shortcomings. Setting up communication channels within the District Municipality has been a difficult exercise. This was due to lack of clarity in the roles of the officials within the District Municipality. The water level and flow meter readings recorded in logbooks have not yet been captured into the GIS as a GIS monitoring database for the Chris Hani District Municipality is currently under construction.

Conclusion

The field visits that were carried out helped in identifying the borehole infrastructure to be installed in each borehole and key training requirements in each village. Although the results used were from one specific area, it proves that proper training of pump attendants can improve data

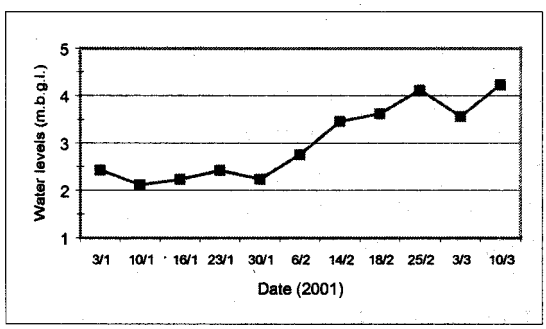

Figure 3. Water levels in a monitoring borehole

collection. It is critical that communication channels function efficiently for the flow of information from the village level to the DWAF provincial level. The survival of the water supply scheme also depends on the maintenance of the groundwater information system. Therefore, on-going monitoring and maintenance is required for the long-term sustainability of rural groundwater supply schemes. The level of monitoring and maintenance varies significantly depending on the nature of the resource and the extent of the groundwater dependency. One of the benefits from this project is that the necessary methodologies and skills to implement groundwater monitoring systems in areas with groundwater supply problems will be documented and publicized.

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