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SUSTAINABLE ENVIRONMENTAL SANITATION AND WATER SERVICES

Managing rural groundwater supplies

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THE SOUTH AFRICAN government has a policy for rural water supply that effectively translates into supplying all rural communities with piped water. Being a relatively arid country, the implication of this is that many community water supplies are dependent on ground water and more and more ground water schemes are being developed.

The paper documents the experiences of a project funded by the Government of Norway (NORAD Programme) and managed by the South African Department of Water Affairs and Forestry (DWAF). The aim of the project is to provide DWAF wi1th guidelines on establishing a groundwater management system for community water supplies. The project forms part of a programme that has the overall objective of improving the sustainability of rural groundwater supplies.

The project has involved piloting the establishment of groundwater monitoring systems in two separate areas with a total of 35 boreholes being monitored. Some of the schemes are being operated by community based water committees and others are operated directly by local government.

Within the overall objective of improving sustainability, the motivation for monitoring ground water is a combination of operational and resource management considerations. From an operational perspective, it gives an early warning system for when equipment is not functioning correctly and allows action to be taken before the system fails. By monitoring the performance of the aquifer, one can preempt failure of the system from over abstraction and be in a position to know which ground water resources are under utilized and have the potential for further development.

The nature of South African geology is such that most boreholes for community water supplies are drilled into hard rock aquifers and are relatively deep (40 to 120m). Most recommended long-term pumping rates are based on one or two day pumping tests. These tests give an indication of the potential yield but due to the nature of fractured hard rock aquifers, it is only possible to establish the actual sustainable yield by monitoring water levels and abstraction over much longer time periods.

Monitoring pre-requisites

The following pre-requisites are needed for groundwater monitoring:

- Equipment – the boreholes needed to be equipped with the facilities for monitoring and the operators needed tools to measure and record information.
    - o Water meter for measuring abstraction
    - o A tap at the source for water quality sampling
    - o Piezometer tube for water level monitoring
    - o A dip meter and a logbook for taking and recording data
- Training for pump operators to take and record data.
- Flow of data from the pump operators to the local authority.

Water quality monitoring

Local government is legally required to have a water quality sampling plan in place. Rather than duplicate this with a separate groundwater sampling plan, the project is working with local government authorities to design and implement their water sampling plans. Because water quality relates primarily to the health of consumers, the sampling plans are focused on the tap or point of supply as the primary sampling point. When water samples from the tap indicate contamination, more samples are taken at various points including the borehole, to trace the source of contamination.

Flow of Information

Figure 1 shows the relationship between the various institutions and the flow of information between them. The focal point of the project is the local government institution and they are the target for building capacity and developing tools for ground water management.

- Data is supplied by the pump operator on a bimonthly basis to the local authority who enters the data in a spreadsheet based software package. The logbooks have a carbon copy so that a complete record of the data remains with the pump operator.
- Summary data is provided to the catchment management agency.
- The legal bindings (abstraction permits and water service provision contracts) are contained in water related acts of South Africa.

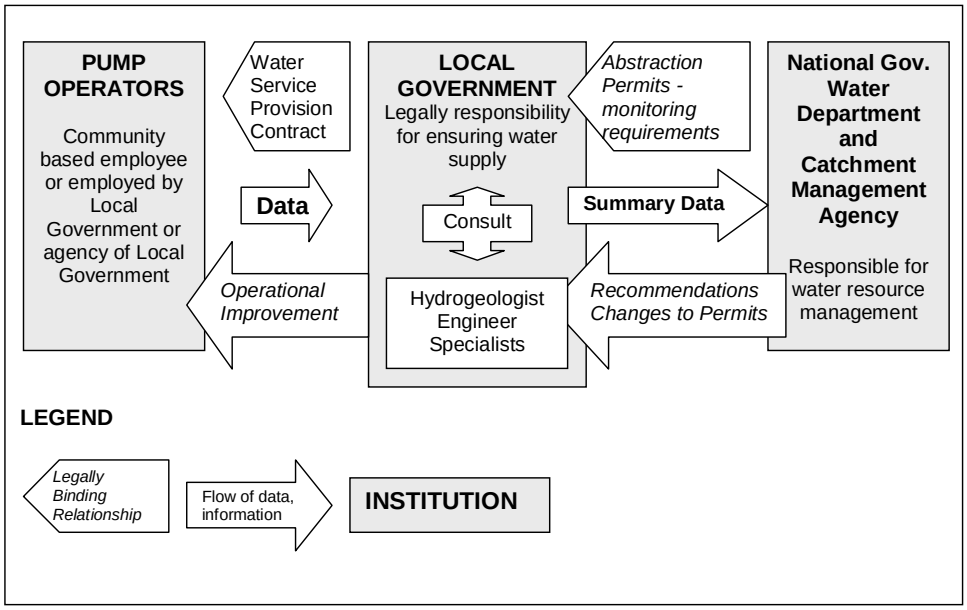

Figure 1 Institutional relationships and flow of data

Aquimon groundwater management software

Aquimon is a GIS based viewer for graphically displaying the borehole time-series data. The data is stored in an excel spreadsheet and the software is a user interface within which one can select a particular borehole. One can then view a series of graphs for the selected borehole and view (and edit) basic borehole information, monitoring recommendations and water chemistry information.

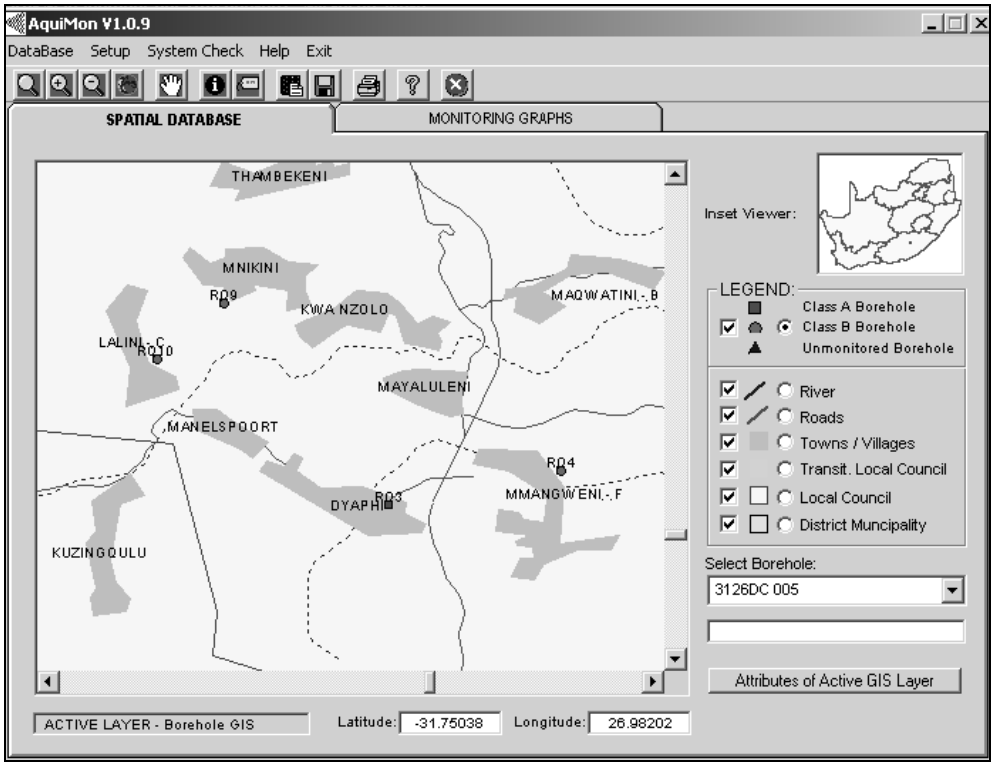

Figure 2. Aquimon user interface

Lessons from the field

Get it right from the start

It is important to implement monitoring friendly projects that are correctly equipped from the start rather than try to retrofit installations. Besides being cheaper to do when the project is being built, it is usually easier to access finance at the construction stage rather than during the O&M phase.

In addition, as part of the water project implementation, potential operators must be trained in taking and recording readings of water levels and abstraction. The training must include practical testing of the operators' ability to take accurate readings and to correctly record them in the logbook. Operation and maintenance training for the institution that will be managing the water scheme must include an overview of the need for ground water monitoring and awareness of issues related to ground water use. In addition, ground water monitoring must be incorporated into the management system for the scheme and must include: checking the monitoring activities of the operator; reporting to and forwarding data to the local authority and maintaining the monitoring equipment.

Integrate with regular operation and maintenance activities

Monitoring of the water resource needs to be integrated with the regular activities of O&M staff at the individual scheme level. The pump operators' job description needs to include the following tasks:

- Measuring and recording water levels
- Reading water meters and recording abstraction
- Recording any other significant information related to the borehole and the pump in the logbook. This would typically include information like: if a flow meter or hour meter was faulty; if the borehole was pumping less water than normal; excessive noise from the borehole; leaks etc.
- Submission of the data to the local authority office on a regular basis. It is recommended that this be done every two months unless required on a more frequent basis. If a borehole/aquifer has the potential to be stressed and the demand from the borehole is close to its maximum yield, supply of the data on a monthly or even weekly basis may be necessary.

Groundwater monitoring should be part of a monitoring system that includes all aspects of a scheme's operation. For a sustainable scheme one cannot just monitor the ground water and not other vital activities like the servicing of diesel engines, determining the water balance and water losses, cleaning of reservoirs, establishing tap water quality, general network maintenance activities and the performance of the operators.

Only process useable data

Log books should be kept for all boreholes - but detailed monitoring of the data is only done for selected boreholes where there is a potential over-abstraction or water quality problem. The management system allows one to classify boreholes into two classes:- boreholes not critical to monitor and boreholes that require regular monitoring. The class of borehole is based upon the frequency of recommended monitoring using the criteria listed below:

MONITORING INTERVAL	WATER LEVEL STATUS	WATER QUALITY STATUS
Daily	**B**	**B**
Weekly	**B**	**B**
Bi weekly	**B**	**B**
Monthly	**B**	**B**
Bi monthly	**A**	**B**
6 Monthly	**A**	**B**
Yearly	**A**	**A**
None	**A**	**A**

Borehole STATUS A
Abstraction within recommended limits
Water level recovery in short and long term
No Water Quality Problems
Minimum Monitoring needed
Borehole STATUS B
Water level and abstraction monitoring recommended
OR Water Quality monitoring recommended

Integration with other water resource management institutions

The national water department and catchment management agencies are responsible for national and regional water resource management respectively. Data from monitoring at the local level needs to be made available to these institutions but it is important not overload them with data that they do not need and cannot process. To accommodate this the management system provides a summary of annual data and additional data that can be obtained if required.

A case study of tambo village

Tambo is a settlement of about 3000 people and is supplied by two boreholes. The one borehole, TAM2 supplies a 340KL storage reservoir and the other, TAM1 pumps directly into the reticulation system.

When the project team first visited the village, the TAM1 borehole was equipped with a positive displacement pump that would pump for about two minutes until the cut off probe in the borehole stopped the pump. It would then recover for about another 3 minutes before switching on again. It was immediately recommended that the pumping rate be reduced from 1.8l/s to 1.0l/s for 18 hours a day and that the total daily abstraction should be limited to 70kl a day. The pump was not immediately changed and eventually burnt out.

At this point the team again recommended a change of the pump size and the pump was replaced with a centrifugal pump that supplies approximately 0.8 l/s.

Subsequent to the pump replacement, members of the project team were informed while on site that there was insufficient water being supplied at Tambo village. Further investigation showed that the pumps were both only pumping for 20% to 30% of the time and that this had been set by a contracted electrician. Again recommendations were made by the project team and the timers were reset to pump for 19 hours and 24 hours a day.

Figure 3 shows that the water levels are responding well to the abstraction at the new discharge rate. Where previousely the pumping water level was 43mbgl and the rest water level was 23mbgl, they are now 20.6 and

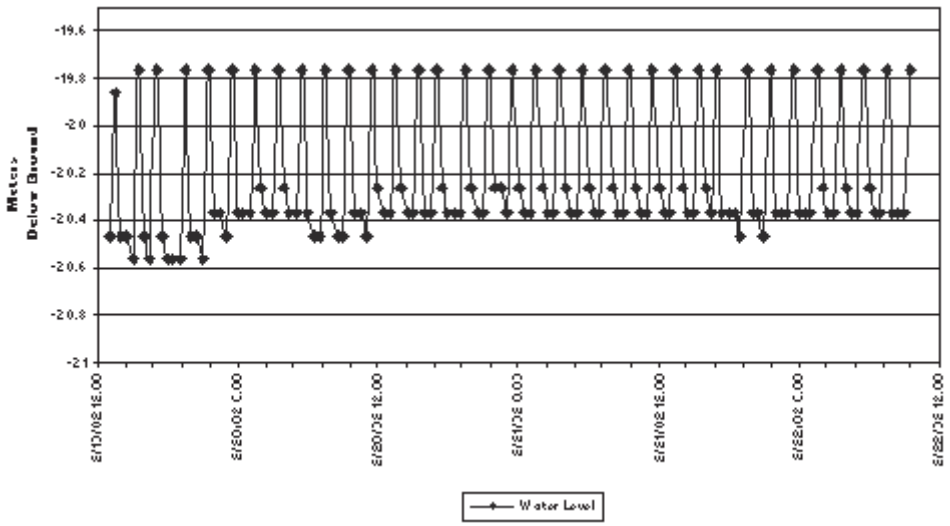

Figure 3. Adjusted pumping routine

19.7mbgl respectively. Figure 4 shows that after the borehole was set to pump at an appropriate abstraction rate in August 2001, the water levels started to recover and are no longer a threat to the pump.

Conclusions

Groundwater management can prevent pumps from operating inefficiently and can prevent pump failure.

Groundwater management is a relatively cheap and simple way to improve the sustainability of water schemes, especially when integrated with the management of operations and maintenance.

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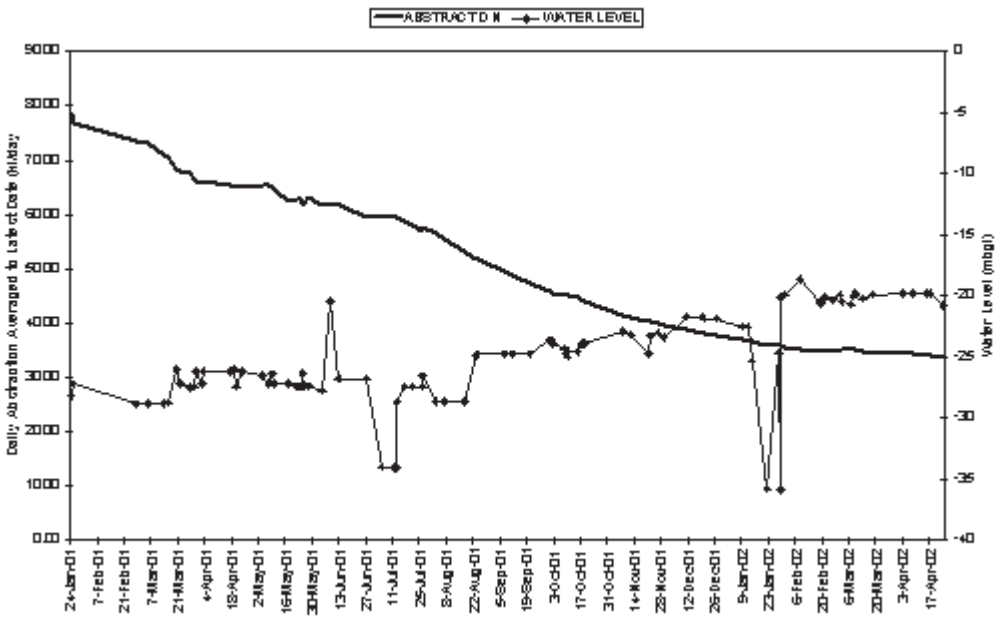

Figure 4. Water level and average daily abstraction