



**DEPARTMENT: WATER AFFAIRS AND FORESTRY**

## **Mpumalanga Groundwater Master Plan**

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## 1. INTRODUCTION

This document will serve as a master plan to be used by Mpumalanga's Regional Management to structure the tasks of the groundwater staff component related to the water functions as set out by the National Water Act of 1998.

A comprehensive discussion of the water functions, as identified in the National Water Act (1998) in relation to groundwater is found in Appendix A.

None of the functions and/or management actions however, can be executed effectively without the necessary data and information. See Appendix B for a comprehensive discussion on sound data/information management principles. One chapter will deal exclusively with data and information management.

Without the necessary staff and the appropriate structures none of the above will be possible. Thus a staff structure and a structure within the Eastern Cluster to execute these groundwater functions will also be proposed.

Typical information products and reports in relation to the strategic and operational decisions that the department has to make regarding groundwater will also be addressed.

The different geohydrological regions (Vegter-regions) will be discussed and where possible, any groundwater activities identified and actions needed to execute these functions proposed.

### 1.1 Purpose

The purpose of this document is to assist the management cadre in the Mpumalanga Region specifically and the Eastern Cluster in general, to effectively execute the required groundwater functions.

At the same time this document can serve as a communication tool between the adjacent Regions and/or Clusters, with overlapping aquifers and the relevant Head Office components as well as bordering countries.

This document can also serve as an input to the Cluster Manager and Regional Director's work plan/performance agreements.

### 1.2 Scope

Groundwater Master Plan strive to address all water functions as identified by National Water Act (1998) for the Mpumalanga Region.

Other related activities and projects that have relevance also need to be recognised, and as the document progresses, these will be added. The relevance and potential impacts these activities and/or projects might have on the improvement of the execution of the functions must be also addressed.

### 1.3 Audience

Management cadre of the Mpumalanga Region  
Management cadre of the Eastern Cluster  
Sub-directorate: Groundwater Information  
Sub-directorate: Groundwater Monitoring and Assessment

## 1.4 Revision

Version 1 is only a draft to kick start the required groundwater functions and it is strongly recommended that it is revised and adapted every six months in close conjunction with the Mpumalanga Region's management structure.

As more detail becomes available and good quality data and information is gathered both the structure and this document must be adapted.

## 1.5 Applicable Documents

1. ISP documents for the Olifants and Inkomati Water Management Areas.
2. National Water Resources Strategy
3. Groundwater Resources Strategy

## 1.6 Acronyms and Abbreviations

Acronym/Abbreviation	Definition
CMA	Catchment Management Agency
D:SLIMS	Directorate: Spatial Land Information Management Service
D:WQM	Directorate: Water Quality Management
DM	District Municipality
ISP	Internal Strategic Perspective
GRAII	Groundwater Resources Assessment, phase II
KNP	Kruger National Park
NGA	National Groundwater Archive (used to capture all groundwater-related data) which will be replacing the Open-NGDB soon.
Open-NGDB	National Groundwater Database running on an open server
REGIS	Regional Groundwater System
SDE	Spatial Database Engine
SGD	Standard Geosite Descriptors
WMA	Water Management Area
WMS	Water Management System (chemical database)
WSA	Water Services Authority
WSP	Water Services Provider
WUA	Water User Association

## 2. WATER FUNCTIONS AS PER NWA IN MPUMALANGA

### 2.1 Introduction

The water functions as identified in the NWA (1998) are the following: -

i) development, ii) utilisation, iii) protection, iv) conservation and v) management. In order to create a common understanding of these terms a comprehensive discussion about them and the tasks related to these water functions, is attached in Appendix A.

### 2.2 Current situation

#### 2.2.1 Monitoring

When talking of groundwater monitoring the reader of this document should understand that it entails the monitoring of groundwater abstractions, water level fluctuations and chemical quality. For a comprehensive discussion on monitoring refer to Appendix D of this document and to van Wyk (2003).

About fifty points are currently being monitored actively for water level fluctuations. The spatial distribution of these points is very uneven and mostly covers the Lowveld portion of the Mpumalanga Region – for the spatial distribution of the current water level monitoring network refer to Figure 1. No knowledge about the reasons for the placement of these points is available due to a high staff turnover. A project to try and establish the value and reasons for these monitoring points has not progressed to satisfaction.

There are about 11 points where chemical monitoring is being done on a six-monthly basis. In terms of the envisaged plan (Simonis, per. comm. circa 1995) there should be between three and five monitoring points per hydrogeological region.

No abstraction monitoring is taking place at all within the Mpumalanga Region and a first priority would be to identify areas where this type of monitoring should start.

To extend the monitoring network one must ask the questions 'what am I monitoring, for', 'why am I monitoring certain points/areas. Thus a systematic approach is needed.

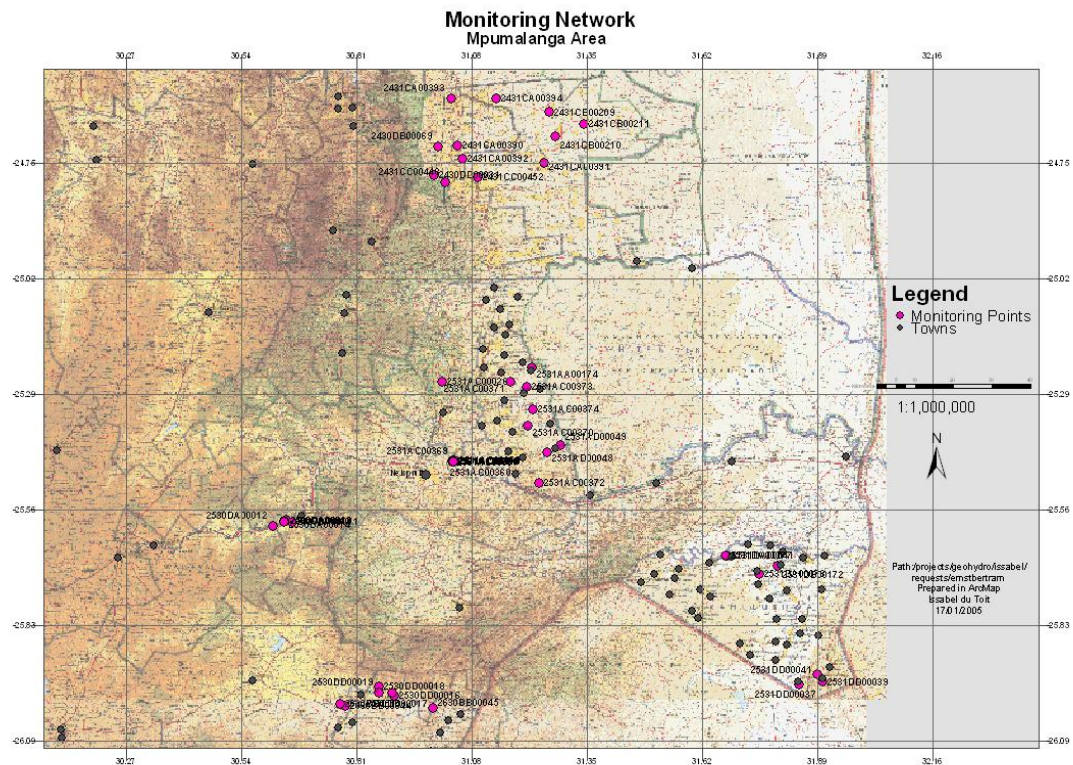
#### 2.2.2 Data management

No data management what so ever in terms of groundwater data, is happening in the Mpumalanga Region. As far as I am aware very little is happening in terms of water quality data either.

To address this problem the following short-term actions can be taken.

- Appoint and train one specialised auxiliary officer in groundwater data capturing.
- Identify all consultants operational in the Region, who was in any way involved in any groundwater development projects in the past.
- Obtain from each of them, a list of available reports. Based on this data decide whether it is necessary to launch a full-scale Groundwater Resources Information Project (GRIP).
- Engage these consultants to ensure that any future projects are duly registered and borehole numbers acquired to ensure that all groundwater-related data reaches the relevant office.

Figure 1: Spatial distribution of existing water level monitoring points



For a discussion on the data capturing functions refer to Appendix A and a introduction to good data management practices, refer to Appendix B. Additional guidance and information on data management can be gained from the 'Groundwater Data Acquisition and Capturing Strategy'.

## 2.3 Conclusion

It is clear that some short-term actions, identified through the previous paragraphs, must be taken to put the data management on a sustainable path. Refer to Table 1 to see the actions needed and the priorities allocated to these.

Table 1: List of short-term actions

Action	Tasks	Priority
Register all current monitoring points ( $\pm 80$ ) on NGA	Complete requested report on each monitoring point with at least the position plus a visual evaluation of purpose, within one month (fifty-one out of the $\pm 80$ already on NGA).	1
Register monitoring points on Hydstra	NGA registration necessary before this task can proceed. The mentioned 51 points already on Hydstra.	2
Load electronic data loggers' data onto Hydstra	Download data from Vota onto PC/Laptop (use this as a training opportunity).	3
Draw up the Route lists for the current monitoring networks	<ol style="list-style-type: none"> <li>1. Divide the current monitoring network into logical routes, i.e. Bushbuckridge, Kwamhluhwa, etc.</li> <li>2. Draw up the route list on NGA.</li> </ol>	4



	3. Update Work Plan for observer to reflect above changes	
Appoint and train a data capturer for all groundwater-related data.	<ol style="list-style-type: none"><li>1. Draw up a job description for such a person.</li><li>2. Draw up an advertisement and advertise post.</li><li>3. Appoint person and provide the necessary training.</li></ol>	1

To place the extension of the monitoring network on a systematic path and to ensure that the correct priorities are allocated, a description of the geohydrological regions will follow. The economic activities which pose potential risks to the groundwater sources will be discussed together with the aquifer properties and potential monitoring actions which could be implemented very soon.

## 3. GEOHYDROLOGICAL REGIONS

### 3.1 Introduction

Vegter (1990) divided the RSA into 64 homogeneous hydrogeological regions based on lithology and climatology. At least five of these regions falls either wholly or largely within the Mpumalanga Region and another four falls partially in this Region. Colloquially these hydrogeological regions are referred to as the Vegter-regions.

The six Vegter-regions that fall largely or wholly within the Mpumalanga Province, are Northern Lebombo, Lowveld, Eastern Bankeveld, North-eastern Middleveld, Eastern Highveld, Eastern Bushveld Complex and the Middelburg Basin. The four only partially within this province are Central Highveld, Western Bankeveld & Marico Bushveld and the Springbok Flats. Of last mentioned four, only the Springbok Flats is of consequence due to the economic activities (irrigation) based on groundwater sources exclusively.

For a comprehensive discussion on each of the Vegter-regions, refer to Vegter (1990). Cognisance must be taken of the subsequent name and rank changes; i.e. sub-region is now a full region, which is treated in detail in Vegter (October 2003).

The Vegter-regions will be discussed individually in terms of known groundwater activities and potential functions to be executed in relation to the activities. As the level of detail regarding these activities are either scares or non-existent, this draft will be in a narrative format with very little detail and data and/or information.

### 3.2 Hydrogeological Map Series

The following four 1:500 000 scale hydrogeological maps cover the Mpumalanga Province, i.e. Nelspruit, Gauteng and Polokwane and Phalaborwa.

The aim of these maps is to depict the groundwater occurrences in terms of four aquifer types, i.e. 1) fractured, 2) intergranular, 3) karst and 4) intergranular & fractured. Five borehole yield classes were used, i.e. 0-0,1l/s, 0,1-0,5l/s, 0,5-2,0l/s, 2,0-5,0l/s and >5,0l/s. When classifying the different regions in terms of 'development potential' the terms extremely low, very low, low, medium and high will be used respectively for the different yield classes. At this point these terms will be used loosely, but in time a more definitive definitions and/or clarification of terms will be produced.

A provisional classification is: -

**Extremely low:** - virtually no groundwater can be found in these aquifers and should there be any water, a wind pump or hand pump could be installed. At best this could be enough for individual household supplies or small number of stock.

**Very low development potential** - one can generally expect enough water for either hand- and/or wind pumps, i.e. small supplies for small communities and/or stock watering and/or single households. Little additional groundwater might be available for community gardening or other poverty alleviation actions. Many boreholes will have to be drilled to obtain a yield at the high-end of the range.

**Low development potential** – more than enough water for either hand- and/or wind pumps, i.e. small supplies for small communities and/or stock watering can easily be supplies. Additional groundwater for community gardening or other poverty alleviation actions will be available. At the high-end of the yield range larger communities from

single boreholes and well fields supplying large communities would be possible. However, due to large variability in borehole yields, an appreciable amount of boreholes will have to be drilled to obtain a yield at the high-end of the range. Pumping at 2l/s for 8 hours per day, 2000 persons can be supplied with water comfortably at 25l/day,

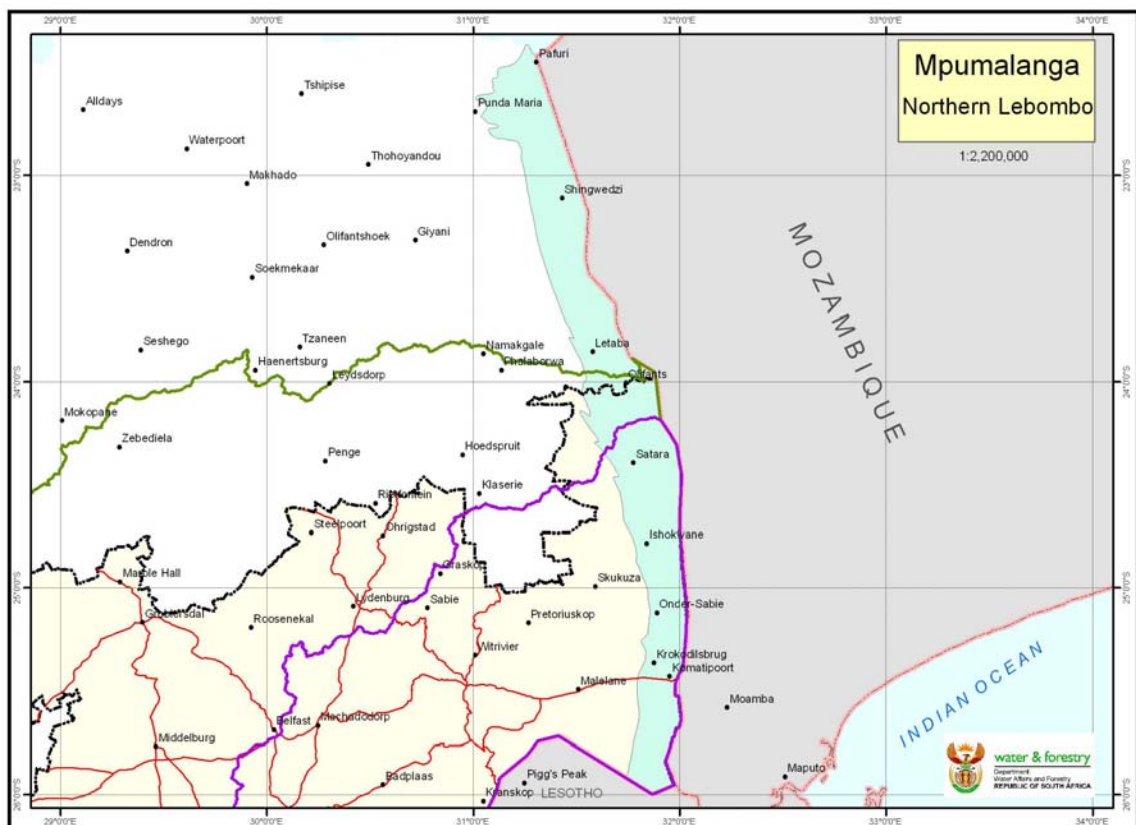
**Medium development potential** – domestic water supplies for large villages, towns and small-scale irrigation from several boreholes would be achievable in aquifers with medium development potential. The amount of boreholes to be drilled before high-end yields that can be expected depends on the variability of borehole yields. Well fields and the concomitant benefit for the management of aquifer(s) make the development of groundwater within medium high potential aquifers very attractive. Pumping at 5l/s for 8 hours per day, 5000 persons can be supplied comfortably with water at 25l/day.

**High development potential** – Large-scale irrigation and/or large village and even large town supplies can be obtained from these aquifers.

At the hand of these definitions, the different hydrogeological regions will now be discussed.

### 3.3 Northern Lebombo Hydrogeological Region

Figure 2: The distribution of the Northern Lebombo Hydrogeological region



## 3.3.1 Economic activities

This region falls nearly totally within the Kruger National Park and thus Nature Conversation and tourism forms the sum total of economic activities. Groundwater use is solely for the purpose of wild animal watering. The abstractions are very low because mostly wind pumps are utilised for abstraction.

Some rural settlements occur in the most southern most portion of this region (south of the Komati River).

## 3.3.2 Aquifer properties and protection measures

Typical aquifers in the region are formed through weathering basins, which according to Enslin (1946), is discontinuous in South Africa. This makes for low yield aquifers in this region. The groundwater functions as described in Appendix A will be discussed in the light of these aquifer properties.

### *Development*

In the light of the low economic activities and no dependence for domestic water supply from groundwater it is envisaged the little further development can and will take place, thus no actions to regulate any development is proposed.

The development potential of this southern-most portion of the aquifer needs to be determined to be able to structure any further groundwater development plans.

### *Utilisation*

No large-scale extension to the current level of utilisation is envisaged and in the light of the extremely low development potential no further development should be encouraged at all.

The level of dependence on groundwater of the rural settlements in this area needs to be determined. The actual use plus the sustainable yield of the aquifer(s) must also be determined in order to evaluate the potential for further development.

### *Protection*

As this region lies in the remoter eastern parts of the KNP, the vulnerability of the aquifer to pollution is not a big concern. Risk is defined as the possibility of pollution even happening x the impact should such a pollution event occurs. Both these elements have a low possibility thus the risk of pollution is low.

Waste disposal sites in the rural settlements however, present possible pollution sources and the methods used for waste disposal in this area need to be established to be able to structure a groundwater quality management plan.

### *Management*

The drought vulnerability of this region is not a big concern as the policy of the Parks Board is one of minimum intervention in the natural cycle and thus requires little management actions in terms of abstraction and water level monitoring. However, bi-annual water level monitoring (one measurement at the end of the dry and one at the end of the wet season) in a limited amount of monitoring boreholes, can only be beneficial.

The level of dependency on groundwater for domestic water supplies in the rural settlements needs to be determined to be able to structure a groundwater

management plan. However, some water level monitoring may be started immediately to obtain baseline reference data.

### *Data/information management*

In spite of all the above low-key evaluation of the region, the management of the KNP must be encouraged to still execute both groundwater management and sound groundwater data management practices.

### 3.3.3 Summary of known problems and risks

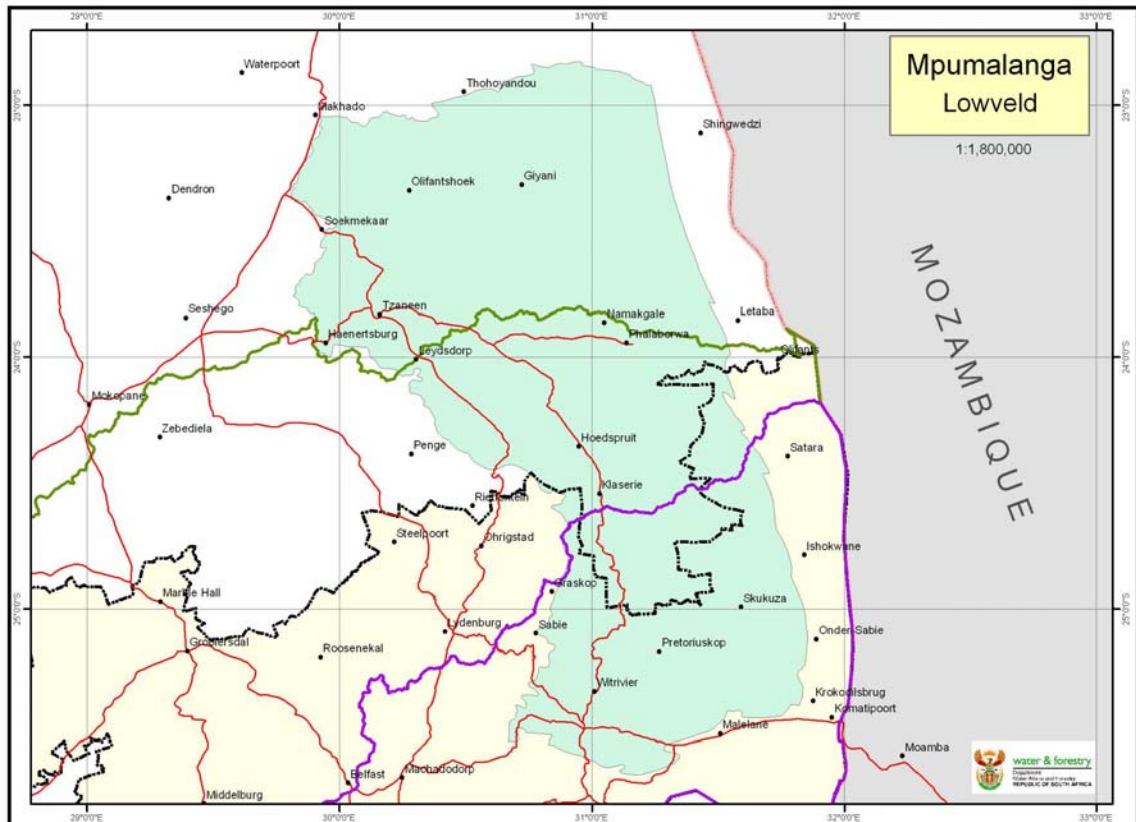
- No or little knowledge of the occurrences of groundwater exists for this region;
- Nothing is known about the vulnerability of aquifers for this region;
- No data is ever received from this region;
- The 'Planning potential' as calculated through the 'Groundwater Resources Assessment Phase II, amounts to xxm<sup>3</sup>/annum. This figure is however of a very low confidence level due the lack of appropriate data;
- No monitoring is done in this region;
- There is no generally known groundwater problems in this region;
- Risk of negative impacts (pollution and over-abstraction) is low;

#### Actions: -

- A survey of the rural settlement to determine their level of dependence on groundwater.
- Methodology to calculate the volume of groundwater being abstracted from rural settlements.

## 3.4 Lowveld Hydrogeological Region

Figure 3: The distribution of the Lowveld Hydrogeological region



### 3.4.1 Economic activities

The eastern portion of this region falls in the KNP and adjacent private game reserves. Nature Conservation and tourism contributes in terms of the economic activities in this region and groundwater abstractions are low.

A lot of rural settlements occurs in the in the southern part of the central portion of this region. The level dependence (solely or largely) of these communities on groundwater is unknown, as is the volumes of groundwater being abstracted. It is thus a high priority to launch a project to determine the level of groundwater use.

Farming with irrigation from probably both surface and groundwater sources are taking place within the western porting of this region (refer to list of irrigation boards in Appendix C). The use of groundwater in this area is anecdotal and no or little knowledge about the level of use and abstraction is known. It is strongly recommended that a project be launched to determine the level of groundwater use for irrigation purposes. As this probably forms the mainstay of economic activities in the area and over-abstraction and misuse potentially has the biggest impact on not only the groundwater resource but also on the economy of the area. The possibility of negative impacts to the adjacent rural communities' water sources is also a concern. Thus the determination of groundwater abstraction is of prime importance.

Forestry forms another economic activity in the western portion of the region, especially at the foothills of the Escarpment. Although very little groundwater is probably being abstracted artificially for this activity, the impact is large in that the trees use a lot of groundwater. The level of use by trees needs to be established in order to establish a valid water balance for the Province. Anecdotal evidence for the Maritie Plantation would suggest that the impact is rather large – a wetland developed after mature trees were cut down and soil mounds had to be made to re-establish young trees.

### 3.4.2 Aquifer properties and protection measures

Weathering basins probably forms typical aquifers in the region. As the rocks underlying this region are most of Swazian age, depth of weathering could be extensive and thus forms extensive aquifers. However, not enough borehole data for this area is available to draw any reliable conclusions.

For a more comprehensive description of the region refer to Vegter (October 2003).

The aspect of low levels of data availability will be discussed under data management. The groundwater functions as described in Appendix A, will now be discussed in the light of the above mentioned aquifer properties.

#### *Development*

In the light of the economic activities in the central and western portion of the region, it is envisaged that the further development of groundwater sources in this portion can and will take place. Before further development can be allowed or encouraged in any way, the level of current groundwater use and the development potential of the aquifers need to be established. Any regulatory actions must be based on a precautionary principle.

#### *Utilisation*

The scale/level of groundwater usage must be determined with the level of dependence for domestic water supplies (rural communities) from groundwater, a high priority. Multi-sectorial use of a common source always creates potential conflict areas and makes this a high priority project.

#### *Protection*

The vulnerability to pollution of the aquifer(s) under discussion is unknown. However, from first principles the risk of pollution is real. The farming sector represent diffuse pollution source in the form of fertilisers and settlements points sources in the form of waste disposal. Based of the principles expounded by Bredenhan & Braune (1992) this area could be due for a high level of protection.

#### *Management*

Drought in this area in not prevalent and any management actions must be directed toward abstraction and water level fluctuation monitoring. The NWA (1998) requires management of water resources to happen at the lowest possible level of government and therefore the creation of water user associations has been codified. To give effect to the law, the establishment of WUA (irrigation boards) based on integrated water management principles, must be promoted vigorously.

The level of vulnerability of this region can be established fairly easily and fast on a regional scale using a GIS and published data and systems. In the mean time management actions in terms of groundwater abstraction and water level monitoring must be instigated within as short a time as possible. The level of dependence on

groundwater sources for domestic water might be established with the help of existing Water Services data (albeit with a low level of confidence) and the existing monitoring network must be evaluated and if necessary extended within three months.

### *Data/information management*

A project to establish the amount of available groundwater data, generated through water supply projects launched by Water Services, must be launched within one month. The GRIP of the Limpopo Province can serve as a working model. However, this project must also be used to establish good data management practices based, on the adaptation of the existing data acquisition and capturing strategy, produced by Head Office, specifically for the Mpumalanga Region.

The establishment of a data capturing and dissemination section (one data capturer) is of paramount importance. The co-operation between Hydrometry and the groundwater monitoring section could possibly be more formalised.

### 3.4.3 Summary of known problems and risks

- Anecdotal evidence indicates that large-scale groundwater abstractions for irrigation, is happening. The extent of the abstraction needs to be quantified.
- Impacts on both the environment and surrounding communities using groundwater will crop up due to large-scale abstractions.
- Irrigation Boards now converted to Water User Associations, although using groundwater to augment their irrigation, never executed any groundwater management. This situation needs to be corrected but without any knowledge on the extent of groundwater use incorporating groundwater management cannot be done systematically.
- Rural communities largely or wholly dependant on groundwater

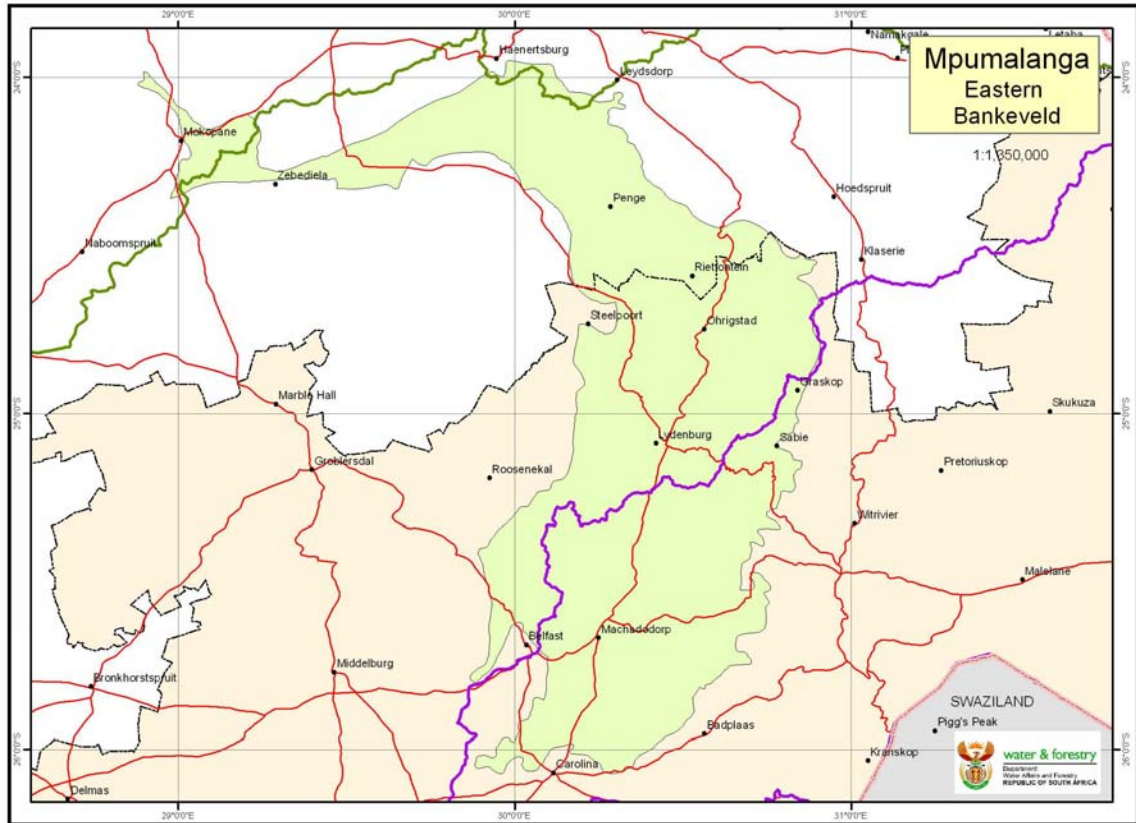
#### Actions: -

- Methodology to determine the volumes of groundwater being used for irrigation by the different irrigation boards/water user associations.
- Level of dependence on groundwater for domestic water supplies in the rural settlements.
- Evaluate the existing monitoring network in terms of the level of dependence on groundwater for domestic water supplies.
- Identify all possible water supply projects and obtain the relevant reports and capture the data onto the NGDB.



## 3.5 Eastern Bankeveld Hydrogeological Region

Figure 4: The distribution of the Eastern Bankeveld Hydrogeological Region



### 3.5.1 Economic activities

Forestry forms the mainstay of economic activity in the largest portions of this region, consisting of pine and eucalyptus plantations. Indigenous forests are not harvested at all. The impact of the forests on both the groundwater and surface water regimes needs to be determined.

Tourism is the next largest economic activity.

In the past gold mining was active in the past but currently does not make a large contribution to the economy of the area. Some base minerals are mined in the Barberton area but little is known about them. The mining activities have the greatest potential for pollution and a first step would be to establish how many mines there are and other, as per SGD, related data.

In the high-lying areas around Dulstroom and Belfast trout hatcheries and fishing forms an important economic activity

Irrigation farming, probably mainly the Ohrigstad Dam, in centred on the town of Ohrigstad. No data or any knowledge about possible groundwater use is available. The Praktiseer communities are also situated in the valley of the Ohrigstad River.

The Ngodwana paper mill lies in the valley of the Elands River. Both the mill and the township use surface water from the Ngodwana River. The mill disposes its waste-water by irrigating fodder upstream of the mill on the banks of the Elands River. Some investigation into pollution of the Elands River through seepage is being investigated.

### 3.5.2 Aquifer properties and protection measures

The region is underlain by rocks of Vaalian age consisting of mainly sedimentary rocks but also some volcanic rocks. The Chuniespoort dolomites form an extremely important aquifer which gives rise to several perennial rivers, i.e. Sabie-, Treur- and Blyde Rivers to name but a few.

The Elands- Crocodile- and Steelpoort Rivers, all of them perennial as well, have their origin in the highlands formed by the rocks of the Pretoria Group. Orographic rain, as well as the porosity of the rocks that underlie the area, contributes water to these rivers. The contribution that groundwater makes to the river flow, needs to be determined and offers an ideal opportunity to study not only recharge but also surface water groundwater interaction.

Umpteen springs and wetlands occur in this area and is the basis for the trout industry.

#### *Development*

Further development of groundwater sources in this region can only be encouraged once the development potential (Reserve determinations) and the current level of groundwater use, has been established. Due to the important contribution the Dolomitic aquifers make to surface water in the area any further development in groundwater use, including the extension of forests, need to be regulated strictly. The interaction between ground- and surface water must be quantified and a project specific for the area, based on the results of the national project (GRAII) must be started as soon as possible.

#### *Utilisation*

The level of groundwater utilisation in the agricultural sector needs to be established as soon as possible (refer to the terms of reference for such a project) before any additional groundwater to be allocated.

#### *Protection*

From first principles it can be deduced that the Dolomitic aquifers is very vulnerable by nature and the impact on the quality of both the ground- and surface waters needs to be established before systematic protection measures can be implemented.

The impact of the trout industry is another area that needs investigations.

The impacts of the mining in this region also need to be investigated. The Water Quality Management directorate may be in a good position to assist with some of the actions identified in this section. These are inter alia the identification of mines and making available all relevant reports to establish the level of monitoring and the capturing of all groundwater-related data.

#### *Management*

In areas where there is multi-sector use of a common groundwater source, i.e. Ohrigstad River valley, immediate monitoring actions need to be implemented. As a first order approach an existing borehole, or boreholes, situated beneficially must be

identified and monitoring started. This is not the ideal situation, as the occurrence of groundwater in the area must be understood conceptually before any water level fluctuations can be interpreted usefully.

### Data/information management

A great need for spatial data relating to forestry and wetlands for this region exists. If and where they exist these layers must be obtained and loaded into appropriate DWAF systems, i.e. REGIS and/or SDE of D:SLIMS. If any future projects of this nature will be launched the ownership and standards of the data must be specified clearly in the terms of reference.

### 3.5.3 Summary of known problems and risks

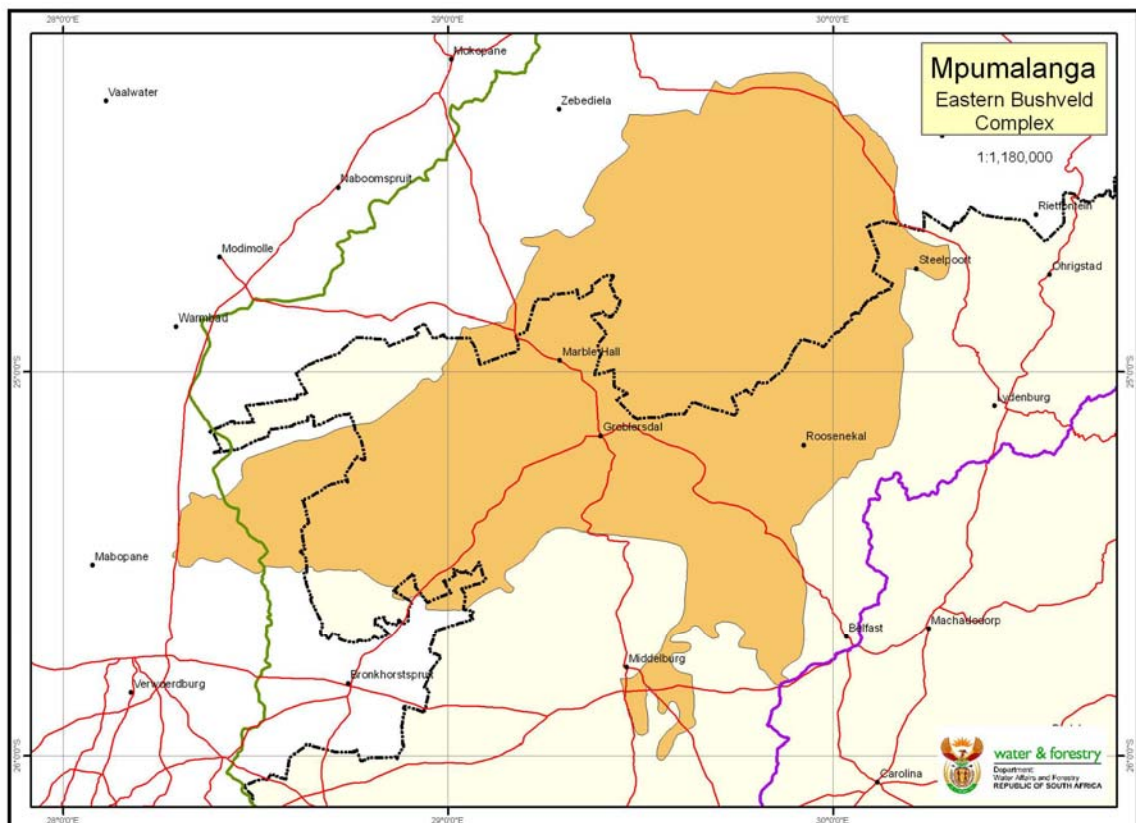
- Lack of data on the level of groundwater utilisation within the agricultural sector, specifically irrigation.
- Lack of borehole data to be able to make useful decisions.

Actions: -

- Determine the volumes of groundwater being used for irrigation;
- Determine the level of dependence on groundwater for domestic water supplies in the rural settlements.

## 3.6 Eastern Bushveld Complex Hydrogeological Region

Figure 5: The distribution of the Eastern Bushveld Complex Hydrogeological region



### 3.6.1 Economic Activities

Mining of the Platinum-group metals forms the brunt of the economic activity in this region.

Agriculture is probably the second largest economic activity in the area. Irrigation along the Waterval's River and dry land crop and stock farming is probably forms the brunt of the farming activities. Large-scale irrigation from surface water is taking place in and around Groblersdal. As mentioned before, groundwater invariably will be used as well. However, the volumes being abstracted are unknown and thus the impact cannot be evaluated.

A few industries inter alia the platinum smelter at Lydenburg, also contribute to the economy of the area.

A scattering of rural villages occurs in the area but nothing is known about their domestic water supply sources.

### 3.6.2 Aquifer properties and protection measures

Igneous rocks of the Bushveld Igneous Complex underlie the area. The hydrogeological map indicate the main aquifer type as 'intergranular and fractured' with borehole yields between 0,5 and 2l/s; thus a medium development potential. Nothing is known about the current level of groundwater utilisation in the area under discussion.

#### *Development*

As this region have a medium development potential means that enough groundwater can be available to supply small to medium sized rural villages. With nothing known about the current level of groundwater utilisation it is strongly recommended that this be determined.

#### *Utilisation*

The mines in the area might not consume large quantities of groundwater but probably pump groundwater out of the mines to keep the working areas dry. This aspect does pose two risks, i.e. the pumped water could contaminate the rivers and cause an undue decline in water levels and thus affect 5th the rural settlement's domestic water source. Once the level of groundwater utilisation is known, it will be easy to define the level of monitoring.

#### *Protection*

The potential impacts on the mining activities can be great as is experienced in the Eastern Highveld region, e.g. acid mine drainage. It is strongly recommended that a list of all the mines be obtained immediately and their own level of monitoring be established immediately. If there are mines that do not monitor at this moment it must be rectified immediately through licensing.

#### *Management*

As there is probably multi-sector use of groundwater, i.e. mines and domestic water for rural villages, in this region immediate monitoring action must be started, even at the very low key, in areas already identified. In support of additional monitoring the areas of potential conflict must be identified immediately, through a GIS-based project where the village coverage and a coverage showing the current mines, is overlain and proximity of the two determined. Monitoring boreholes must then be found or drilled, to monitor the water levels between the mines and the settlements.

#### *Data/information management*

To enable above mentioned project to be successfully executed a survey of all mines is necessary. The level of monitoring executed by each mines can be determined at

the same time. The required data will in all probability be available in-house, from WQM. As this region poses the highest risk of pollution and potential conflict due to multi-sectorial groundwater use, the actions described above is of high priority.

### 3.6.3 Summary of known problems and risks

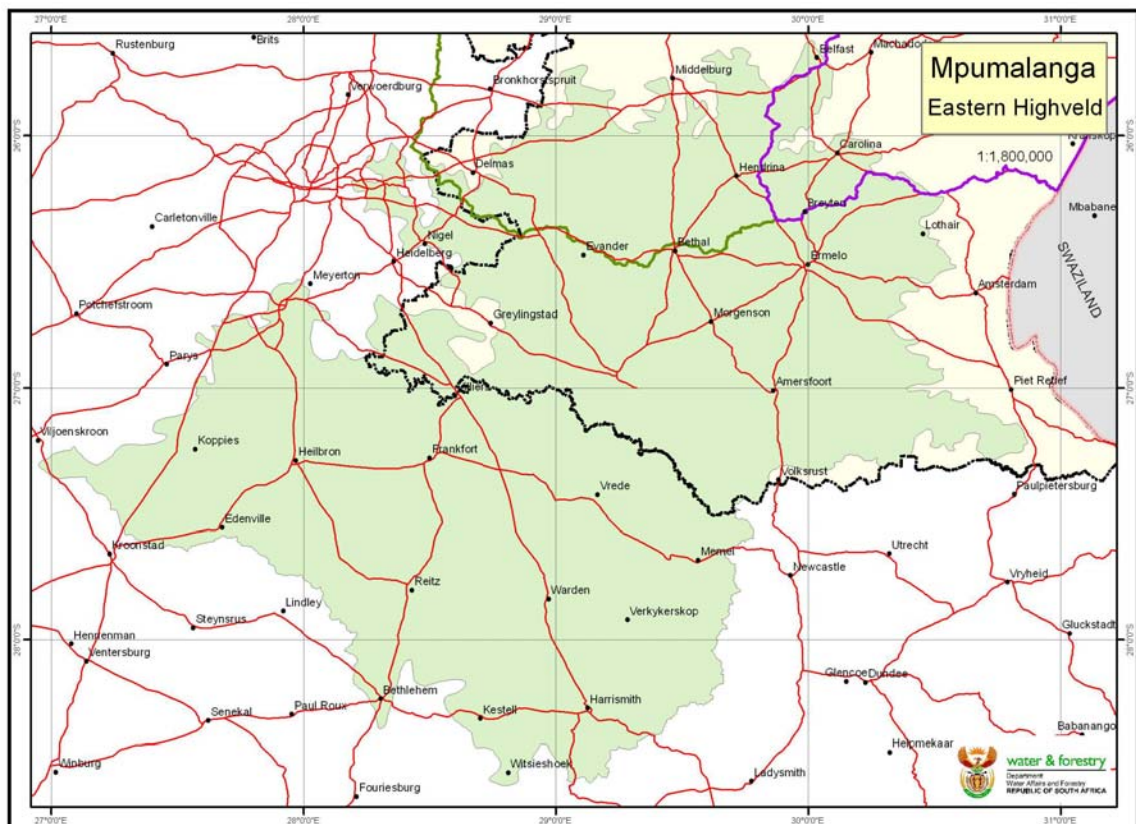
- Lack of appropriate groundwater data is hampering any possible decisions regarding protection and/or management of groundwater.
- The amount of groundwater used within the mining sector is unknown and thus the impact on groundwater cannot be evaluated at all. The mine use poses a large risk especially with the close proximity of rural settlements which are in all probability completely dependent of groundwater for their domestic water.

Actions: -

- Collect all available data in this region and capture it in the Open-NGDB.
- Conduct a survey to verify the data and fill the gaps in terms of domestic water use.
- Set up a water users association for the region and draw up a comprehensive groundwater management plan. For a comprehensive insight into the envisaged tasks refer to the terms of reference for the proposed project.

## 3.7 Eastern Highveld Hydrogeological Region

Figure 6: The distribution of the Eastern Highveld Hydrogeological Region





## 3.7.1 Economic Activities

Coal mining and electric power generation, due to the proximity of coal deposits, forms the mainstay of economic activities in this region. Several towns own their existence to the mining activities.

Dry land crops, with maize and sun flowers the main crop, probably forms the only other main economic activity and several towns own their existence to this activity.

Nothing is known about the level of groundwater use by either, the towns, mines or the power generation plants.

The mines and the slag heaps of the power generation plants, however poses a real pollution thread to the area, i.e. the well-known acid mine drainage, which has already polluted several streams and rivers. The impact on groundwater has not been quantified yet.

## 3.7.2 Aquifer properties and protection measures

The Eastern Highveld Hydrogeological Region covers virtually the whole southern portion of the Mpumalanga Province. The rocks found here belong to the Ecca Formation, which forms part of the Karoo Supergroup. The rocks were formed during the Permian Erathem, which was an extremely wet period in the history of the earth, hence the coal deposits, which occur throughout this region.

The hydrogeological map (Johannesburg) shows this area as having intergranular and fractured aquifer with a low to medium development potential, and no known large-scale irrigation.

In terms of the pollution risk (risk = potential of a pollution event happening X impacts) this region seems, at first sight, to be a low risk area although the potential for pollution is high. It is however, important that this premise be tested.

### *Development*

As little is known about the level of groundwater use in this area, no comment about further groundwater development in this area can be made. The results of a recent project launched by the Seme District Municipality, to supply some towns must still be submitted to the DWAF and studied before any more comments can be made.

The lack of adequate groundwater data, however, can be highlighted at this point in time and a strong recommendation that the HO data acquisition strategy be adapted for the province specifically and implemented. Refer to appendix B regarding good data management practices.

### *Utilisation*

Nothing is known about the level of groundwater use and data must be collected before any comments can be made. However, due to the low development potential it is not a high priority.

### *Protection*

The low development potential of the aquifers underlying this region, indicates that protection is also a low priority. Some studies might already be available through projects initiated by the mines and this need to be collected and the data and information synthesized to create a more comprehensive image.

## Management

Again the total lack of data and information needs to be addressed before any more comments can be made.

## Data/information management

It is clear that data management needs urgent attention. It could be that through projects launched by the mines and mining industries, a lot of data is already available. This must be established and if correct, the data must be collected and captured.

### 3.7.3 Summary of known problems and risks

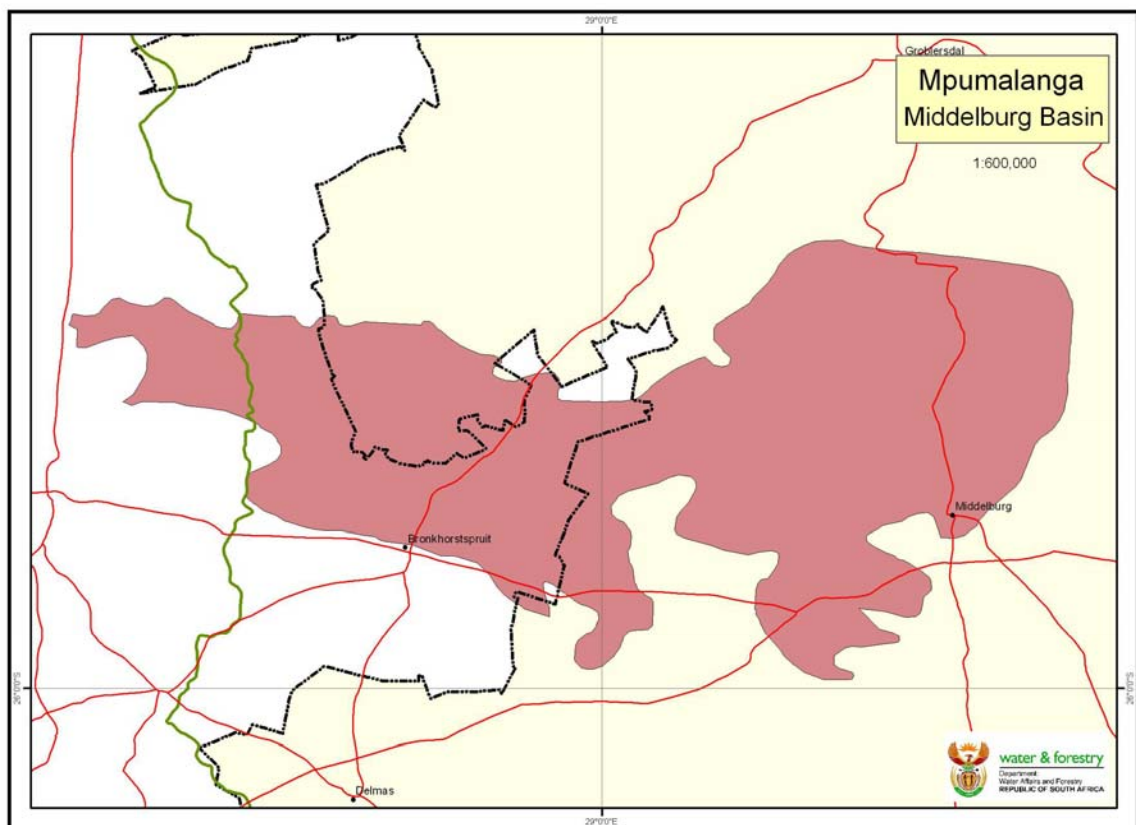
- Acid mine drainage and the resultant pollution of surface water sources, is a big problem.
- The extent of groundwater use within the agricultural sector is hampering any decision regarding the implementation of groundwater management.
- The current level of groundwater pollution.

#### Actions: -

- Survey of agricultural groundwater use, especially for irrigation.
- Hydrocensus to determine the level of groundwater contamination due to mining operation and power generation.

## 3.8 Middelburg Basin Hydrogeological Region

Figure 7: The distribution of the Middelburg Basin Hydrogeological Region



## 3.8.1 Economic Activities

The only economic activity in this region seems to be extensive livestock farming.

The towns of Middelburg and Witbank lie in this region and two steel manufacturers are the two industries that pose the largest risk of pollution.

No known large-scale groundwater abstraction is shown on the hydrogeological map.

## 3.8.2 Aquifer properties and protection measures

The hydrogeological map shows the Middelburg Basin as containing fractured aquifers with a low development potential.

### *Utilisation*

No data on the level of groundwater use is available. Extensive rural settlements occur in this region but their level of dependence on groundwater is not known. The area known as the Western Highveld is currently being served from surface water sources. It is very bad that most of the settlements were successfully served from groundwater but since the surface water distribution network was installed, groundwater use fell into total disuse.

### *Protection*

As these aquifers have a low development potential and the pollution risk is low, any protection activities will take, in accordance to the 'Policy and Strategy for Groundwater Quality Management in South Africa', a low priority.

### *Management*

See comments above.

### *Data/information management*

In the light of all the above comments data management for this region also takes a low priority.

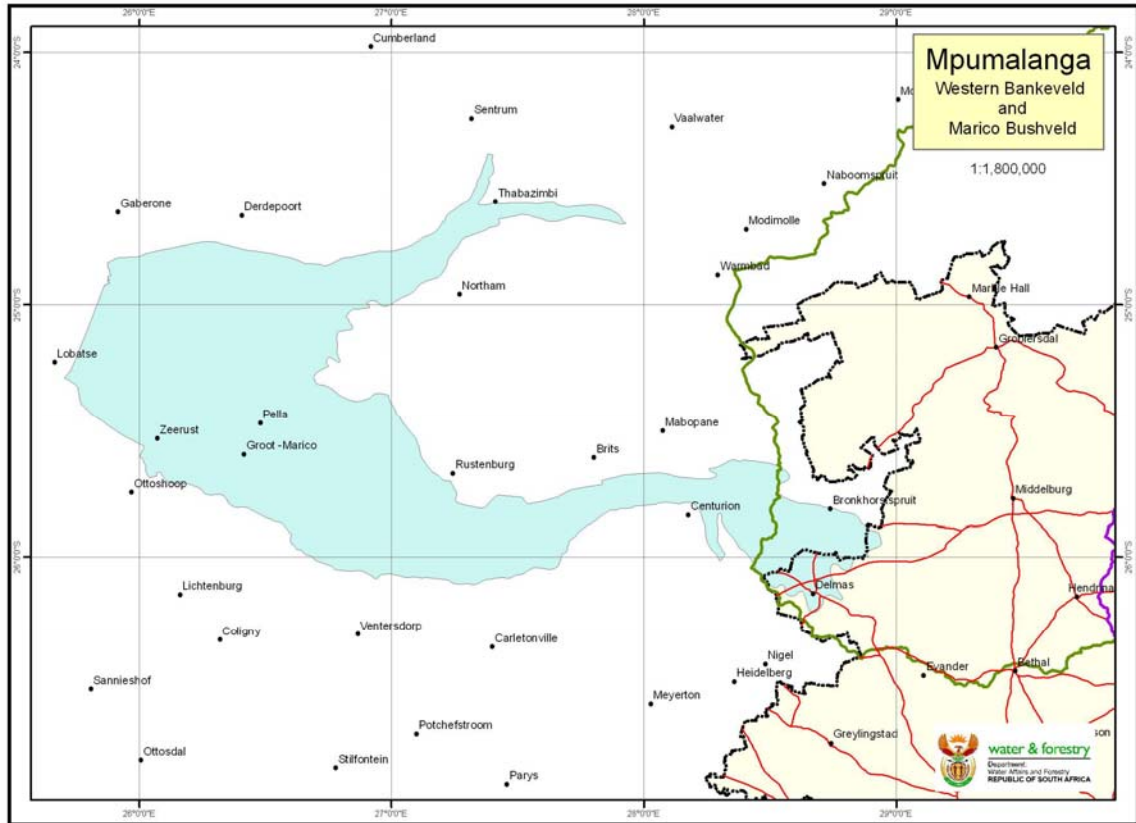
## 3.8.3 Summary of known problems and risks

- Lack of knowledge on the current level of pollution by the mines and power stations.
- Lack of knowledge about the level of dependence of rural settlements, outside the western Highveld, on groundwater.



## 3.9 Western Bankeveld & Marico Bushveld Hydrogeological Region

Figure 8: The distribution of the Western Bankeveld & Marico Bushveld Hydrogeological Region



### 3.9.1 Economic Activities

The area of this region occurring in within the boundaries of the province is very small. The main economic activity is farming under irrigation from groundwater. The aquifer being tapped is a karst aquifer.

Nothing else is known about the area.

### 3.9.2 Aquifer properties and protection measures

The karst aquifer(s) from by the Littleton and Monte Christo Formations are highly productive but also prone to the forming of sinkholes. Two recognised mechanisms operate to form sinkholes. These are: – a) leaking pipes and other sources of leaks, i.e. swimming pools, and b) lowering of the water table more than 15m – due to large-scale groundwater abstraction.

Although aquifer boundaries could mostly conform to catchment boundaries, karst aquifers in South Africa neither conform to catchment nor political boundaries. In the light of this, and to overcome the danger of piecemeal development and management of this important groundwater source, a policy decision has been made that the karst aquifers will be managed as a unit. This policy has already been implemented for the West Rand karst aquifer. As the largest portion of the East Rand karst aquifer falls

within the boundaries of the Gauteng province, this policy will also apply for this karst aquifer.

As this aquifer has the potential to yield large quantities of water to the stressed Western Highveld surface water scheme. However, the project to quantify the development potential is still ongoing.

### *Development*

The recent sinkhole that formed in the Babsfontein area, indicate that the water levels have dropped below the critical 15m and over-abstraction is in all probability, taking place. No further development can be allowed until such time as the Reserve and development potential has been determined.

### *Utilisation*

The level of groundwater utilisation still needs to be determined.

### *Protection*

Karst aquifers are by nature very vulnerable to pollution due to the porous nature of the rocks and the propensity to form sinkholes, which forms a direct conduit for pollution into the aquifers. Due to the solution channels generally found in the karst terrains, flow speeds are generally high and thus any pollution can spread fast and contaminate the whole aquifer.

Hence protection measures on karst aquifers should be strict. At this point in time, however, the Mpumalanga province should not actively involve themselves in these activities, as it will be adequately addressed from Head Office. Once management structures are set up, this province should be part and parcel of this structure.

### *Management*

Due to the small portion of this region lying within the Mpumalanga province and the other urgent needs as depicted in the foregoing paragraphs, the Mpumalanga province should not actively involve themselves in any management activities, as it will be adequately addressed from Head Office. Once management structures are set up however, this province should be part and parcel of this structure.

### *Data/information management*

Will be adequately addressed from Head Office and the monitoring is done by the Gauteng Province by personnel stationed at Boskop. All monitoring data is captured on Hydstra and through the implementation of Citrix, will be accessible in any office in the country with a Hydstra facility.

## 3.9.3 Summary of known problems and risks

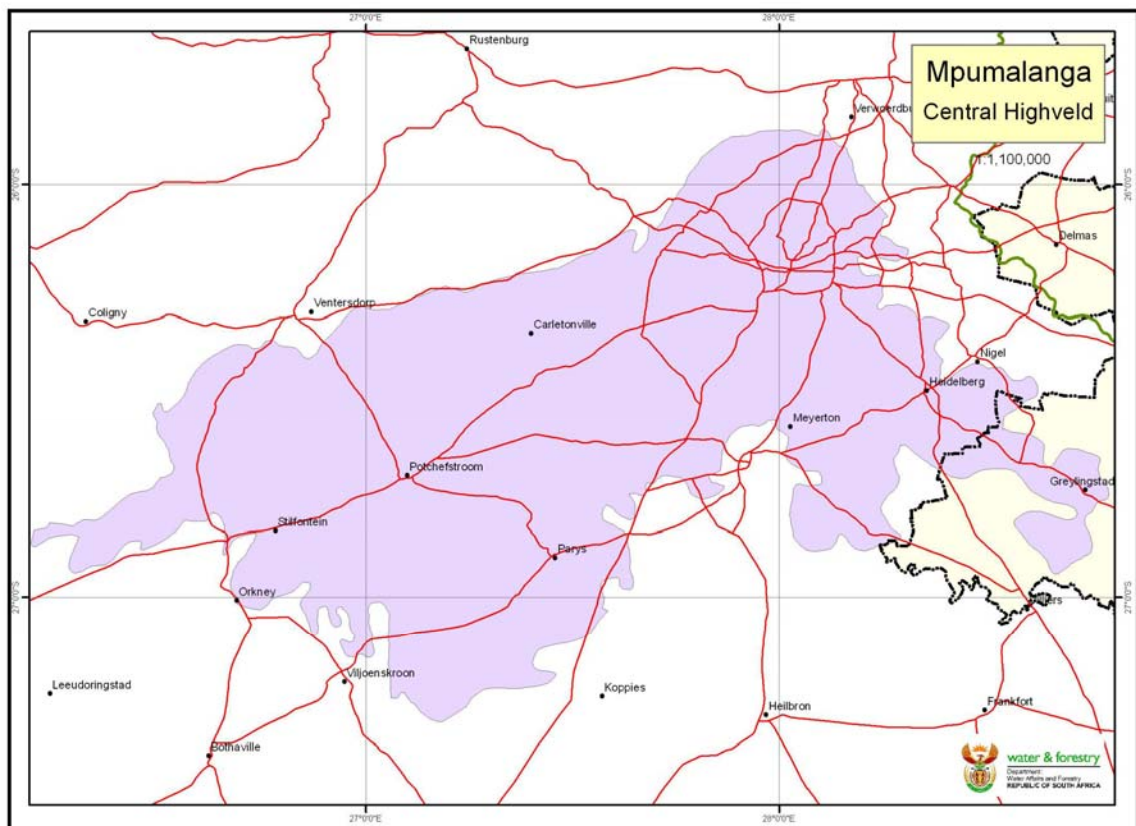
- Sinkhole formation is prevalent in this region, probably due to the uncontrolled groundwater abstraction.
- Uncontrolled, and probably unlawful, groundwater abstractions for irrigation.
- Over-abstraction due to the uncontrolled nature of groundwater use.
- Risk of pollution is high due to the many sinkhole and/or proto-sinkholes occurring in this region.

Actions: -

- Verify and validate groundwater use in the area underlain by dolomite specifically.
- Form a water users association for the dolomitic aquifers specifically.

## 3.10 Central Highveld Hydrogeological Region

Figure 9: The distribution of the Central Highveld Hydrogeological Region



### 3.10.1 Economic Activities

An extremely small portion of this region falls within the boundaries of the Mpumalanga province. The economic activities comprise coal mining and power generation and dry land crops, mainly maize and sunflowers.

### 3.10.2 Aquifer properties and protection measures

The aquifers for this region, lying within the boundaries of the Mpumalanga Province, are mapped as fractured and intergranular with 'low development potential'.

#### *Development*

Little groundwater development in this area is envisaged.

#### *Utilisation*

Nothing is known about the level of groundwater utilisation in this area but considering the small spatial extent, this can be considered a low priority area.

#### *Protection*

Although coal mining is taking place, the protection of the aquifer(s) should be linked to similar activities in the adjacent province.

## Management

As it is a low priority area nothing will be done in terms of groundwater management in the foreseeable future.

## Data/information management

As it is a low priority area nothing will be done in terms of the collection of groundwater data in the foreseeable future.

### 3.10.3 Summary of known problems and risks

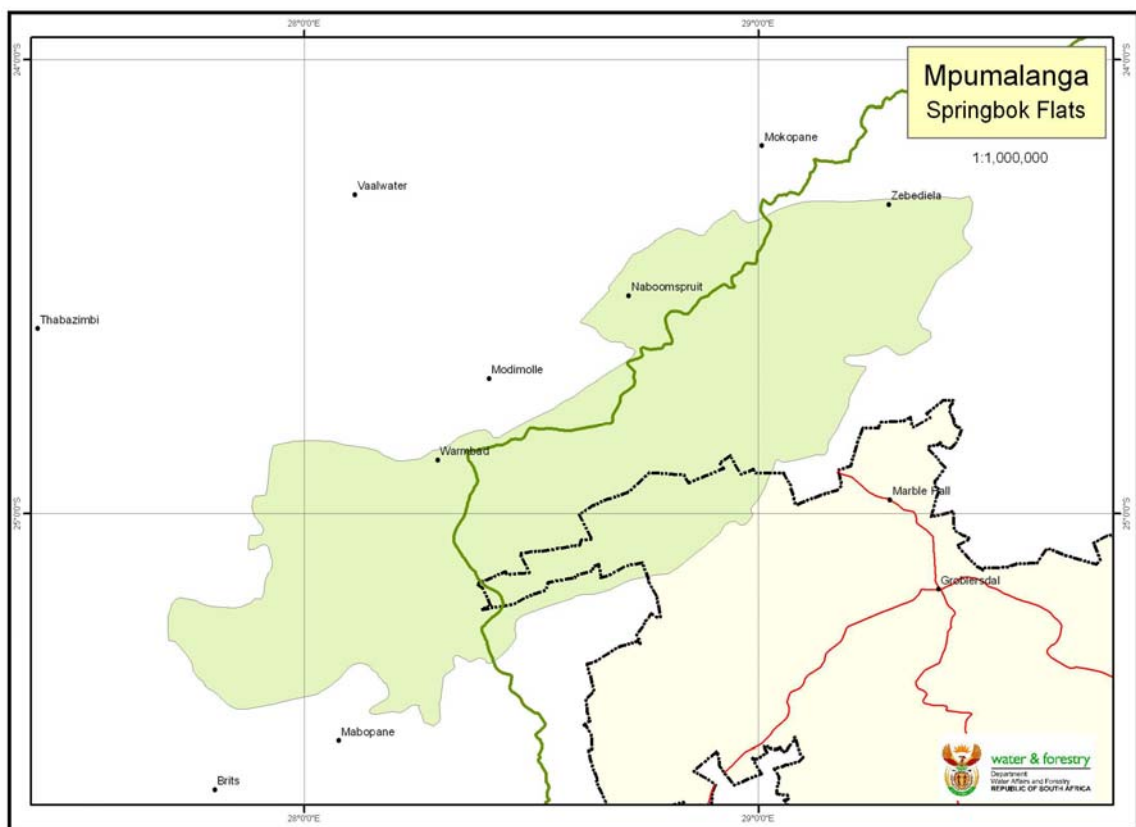
- No known groundwater problems exist in the Mpumalanga portion of this region.

Actions: -

- A visual inspection of the area to ascertain whether there are no problems is recommended.

## 3.11 Springbok Flats Hydrogeological Region

Figure 10: The distribution of the Springbok Flats Hydrogeological Region



### 3.11.1 Economic Activities

Irrigation farming is the main economic activity in this region. Several groundwater studies have been conducted in this region to determine the level of groundwater use and sustainability. The most comprehensive and recent studies are by Fayazi (1994) for the Northern and Nel (1992) for the Southern Springbok Flats.

The extraction of coal was investigated but never materialised - in future however, this reserves could still be developed in future.

### 3.11.2 Aquifer properties and protection measures

The Letaba Basalt and Clarens Sandstone Formations of the Karoo Supergroup underlie the Springbok Flats Hydrogeological Region. High yields are obtained from both the basalts and sandstones which are mapped as 'intergranular and fractured' aquifers. This region has a high development potential.

Although the recharge mechanism for the Springbok Flats is still not well understood, neither Fayazi nor Nel, reports any negative impacts on the aquifers under current abstractions conditions.

#### *Development*

Neither Nel nor Fayazi, comments on the further development potential of this region and this would be a priority area to investigate as some rural settlements occurs on or near this region.

#### *Utilisation*

The level of groundwater utilisation by the irrigation farmers is well established although the volumes abstracted are rather outdated. As this is an area with a high development potential, the WARMS-data need to be verified and validated as a high priority.

#### *Protection*

Some of the groundwater investigations done on the Springbok Flats, centred on the occurrence of high nitrate values in the groundwater. Porszasz (1963) ascribed the high nitrate to pollution due to the farming activities. Recent studies in Alldays (Verhagen, et al; 2002) however, found that natural decay of deep-rooted plants could contribute nitrate as well. If the groundwater from this area is going to be used for domestic water supply purposes, the causes and occurrences of nitrate needs to be studied in-depth.

The current monitoring network also needs to be evaluated and possibly, optimised, which could include the establishment of new monitoring points.

#### *Management*

Due to the high level of groundwater use and the high development potential of this area, the establishment of water user associations in both the Southern as well as the Northern Springbok Flats, is a high priority.

#### *Data/information management*

As a priority it must be checked whether all data contained in reports regarding the Springbok Flats, has been captured onto the OpenNGDB. All outstanding data must then be captured and a search of any newly produced data must be made and if found captured.

### 3.11.3 Summary of known problems and risks

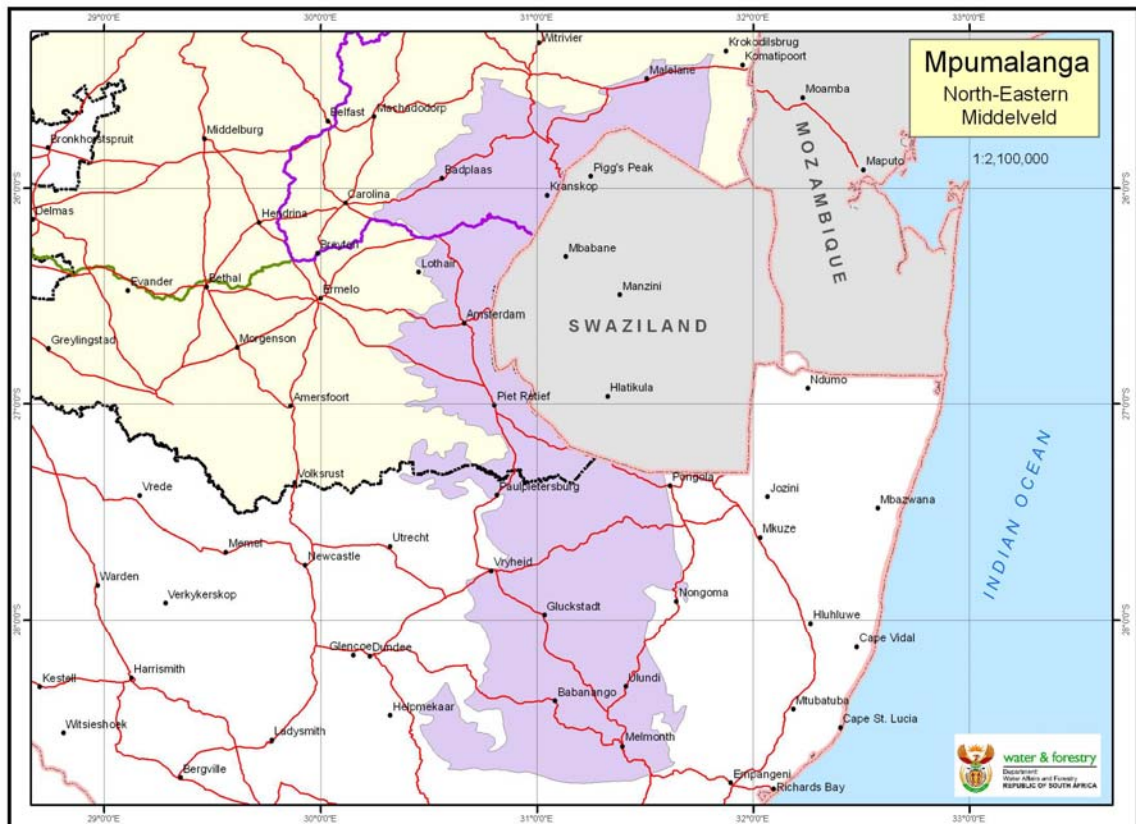
- Potential over-abstraction due to uncontrolled groundwater use.
- Nitrate pollution

Actions: -

- Establish water user associations; one for the Southern and one for the Northern Springbok Flats.
- Investigate the occurrence of nitrate further.

## 3.12 North-eastern Middelveld Hydrogeological Region

Figure 11: The distribution of the North-eastern Middelveld Hydrogeological Region



### 3.12.1 Economic Activities

Forestry probably forms the mainstay of economic activities in the hydrogeological region.

Some mining activities occur in the Barberton area, however, at this point in time nothing is known about the possible pollution impacts.

Many rural settlements occur in this region.

### 3.12.2 Aquifer properties and protection measures

The aquifers occurring in this region is mapped as having a medium development potential and consist of intergranular and fractured aquifer types.

#### *Development*

Some potential for additional groundwater abstraction probably exists in this region. However, the current level of utilisation needs to be determined.

#### *Utilisation*

The many rural villages occurring in this region are in all probability dependent on groundwater for domestic water supplies. This however, needs to be determined.



## *Protection*

With no knowledge about the level of dependence of groundwater no useful protection actions can be defined.

## *Management*

The highest concentration of existing monitoring boreholes in the Mpumalanga Region occurs in this region. However, a task to evaluate the usefulness of these points was never completed. To be able to judge the effectiveness and possible extension of the monitoring network the dependency on groundwater as a source of domestic water needs to be determined as well as the current level of use.

As it is a requirement of the NWA (1998) that water management must be devolved to the lowest possible levels, i.e. water user association, once the level of dependence and use has been established, a groundwater management plan need to be drawn up and the management of the source(s) devolved to the district municipality.

## *Data/information management*

The mentioned report must be completed immediately, the points registered onto the NGA and then onto Hydstra. After these steps have been completed, all available water level data must be loaded onto Hydstra immediately.

### 3.12.3 Summary of known problems and risks

- No data available on the level of dependence on groundwater for domestic water supplies.
- Nothing is known about the volumes of groundwater being abstracted.

#### Actions: -

- Devise a methodology to determine the water use by rural settlements
- Calculate the groundwater use in this region.
- Execute a visual inspection of the region to determine whether there are other groundwater issues that are not addressed in this plan,

## 4. CO-OPERATION

In order to achieve all the goals for an effective groundwater programme, co-operation between the different directorates and sub-directorates is a prerequisite. However, up to now no formal agreements and/or policy exists to formalise this co-operation. In the following paragraphs the nature of this co-operation will be outlined but should it be deemed necessary for formal agreements these will have to be forged outside this plan. The following directorates have played some part in groundwater and/or made major contributions.

### 4.1 Water Quality Management

This directorate is tasked with the protection of the water resources of the RSA. As such a large portion of their involvement is about protecting groundwater from pollution by waste site, sewage treatment plants, etc. The mechanism through which this is achieved is Environmental Impact Assessment investigations (EIA) and Environmental Protection Management Plans (ERMP). The evaluation of the relevant groundwater issues contained in these reports is the point of contact with Geohydrology.

To enable a smooth and efficient co-operation the following standards and guidelines should be implemented by this directorate where and whenever groundwater investigations are executed as part of an EIA: -

- *Standard Geosite Descriptors* – these descriptors were written down to standardise the description of all relevant aspects of groundwater.
- *Borehole Numbers* – each of the nine Regions has a unique numbering system for boreholes and is meant to be used by all involved in groundwater development and management. The required numbers should be requested before any drilling and/or hydrocensus is started and the numbers will be allocated against a project together with the consultancy and the person responsible for the execution of the project.
- *Copy of report* – two dedicated copies of any and all report(s) containing any geohydrological data should, on completion of the work, be handed over the relevant Regional office for the capturing of the data and for archiving. One copy will be held in the relevant Regional office and one copy at Head Office.

To ensure the adherence to the above points, it is imperative that these conditions should be written into any EIA Scoping Report.

### 4.2 Water Services

In the past the Branch Water Services was directly involved in water supply projects. In particular parts of the country the source of domestic water was wholly or largely groundwater. The role of Water Services has changed in the recent past and in all probability will be changing more in the near future in that they will finance and oversee water supply projects. In the case where groundwater will form the largest portion of the source the steps as set out for the Water Quality Management directorate, will also apply.

### 4.3 Water Use and Allocation

The task of this directorate is the allocation of water use licences which inter alia includes groundwater. A large portion of their current work includes that verification of registered water use. In the process many groundwater users are identified. If the



data regarding groundwater use is collected in a way that enhances the work of the geohydrologists, severe geohydrology staff shortages will be alleviated.

## 5. REPORTING OF DATA AND INFORMATION

### 5.1 Introduction

The required information and type of reporting must suite the operational and strategic needs of the department in support of its mission and objectives.

However, no clear-cut definition of what and/or which information products and how often these are required is available. The following Directorates needs to be contacted to find out their needs: -

- Water Use and Conservation;
- Water Use Licensing;
- Systems Planning;
- Hydrological Services;

This aspect in itself constitute a project; It is however, suggested that it be conducted in-house.

## 6. SUMMARY

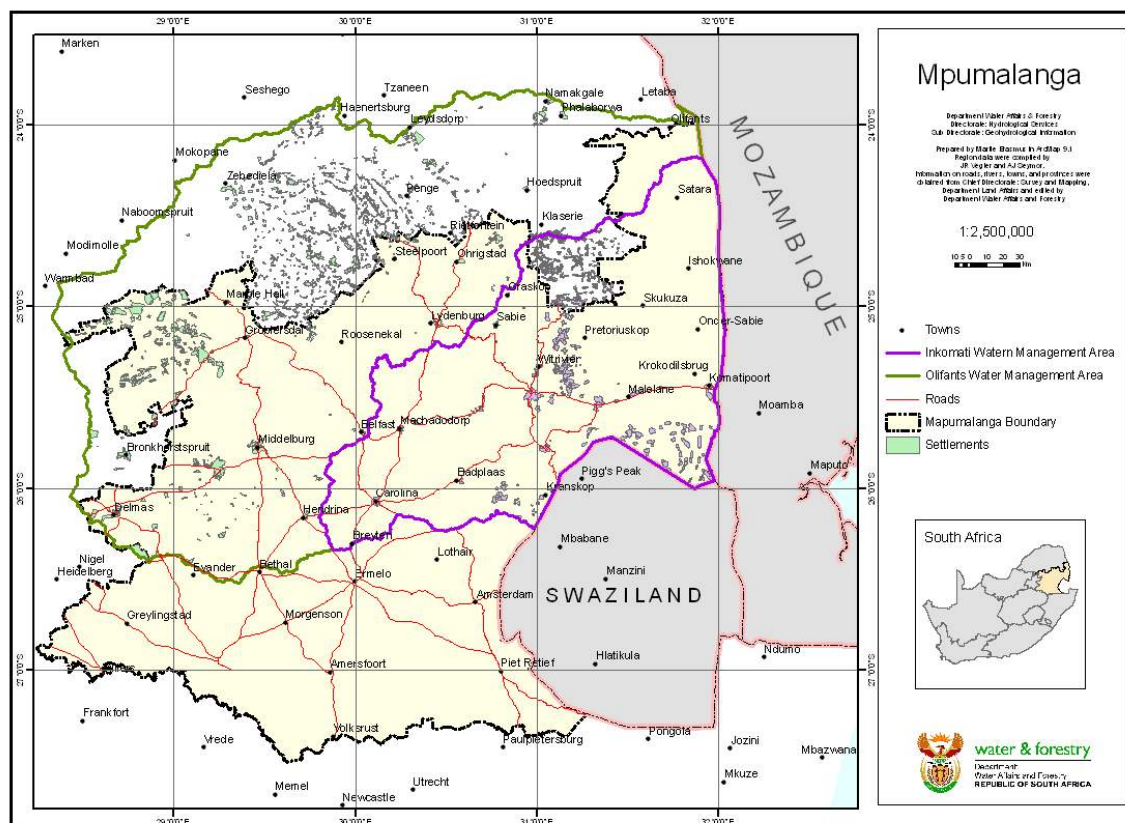
### 6.1 Rural water use

There are approximately 1 000 rural settlements within the area of jurisdiction of the Mpumalanga Regional office - refer to Figure 9 for the spatial distribution of the rural settlements Mpumalanga Province.

In all probability most of these settlements would be largely of wholly dependant on groundwater for their domestic supplies. This represents a sizable component of the domestic water use sphere, but with little or no data on their a) dependence on groundwater, b) their vulnerability to droughts and c) the volumes being abstracted, that is the size of the impact on the groundwater resources of the underlying areas, no proactive action can be taken in terms of mitigating either vulnerability or the supply in terms of water shortages.

Although the water supply to users is a Water Services Authority issue, central government cannot take any pro-active steps when and where problems arise. Currently the government can only take reactive steps.

Figure 12: Spatial distribution of rural settlements in Mpumalanga Province

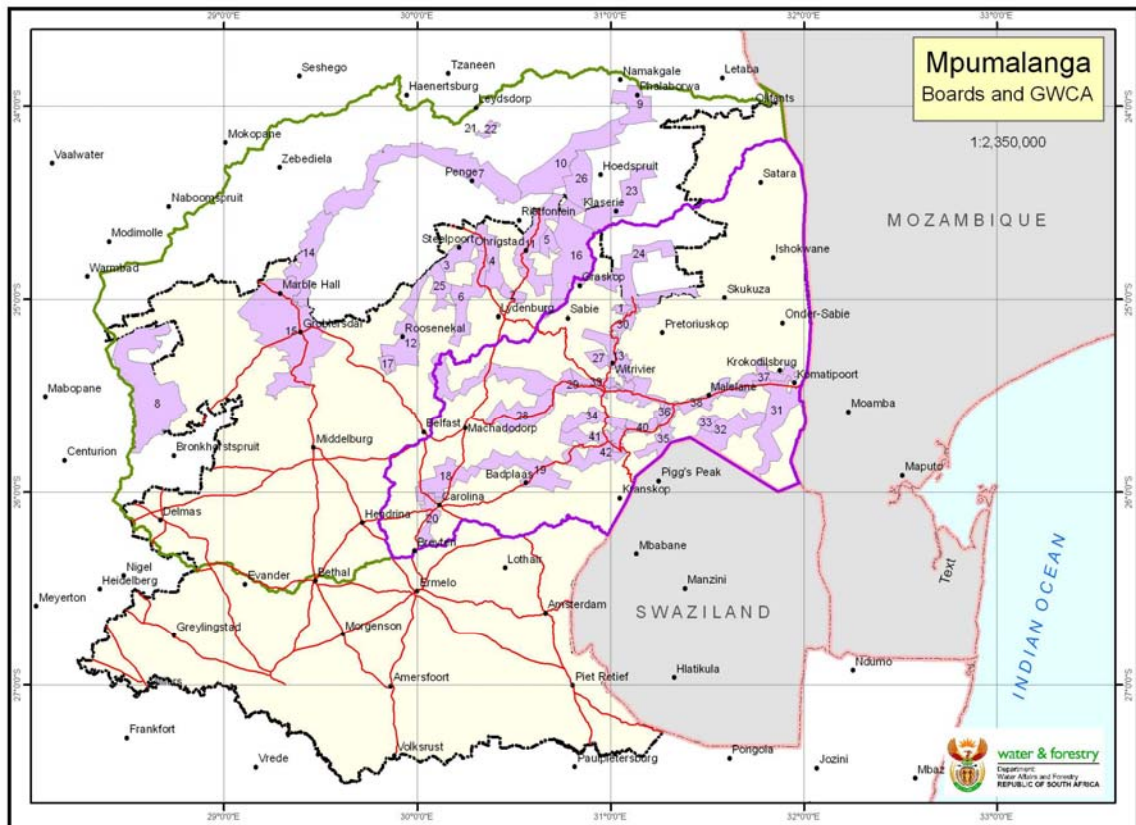


With the above in mind a project to develop and test a methodology to calculate with reasonable confidence level, the volumes of groundwater being abstracted in the rural communities. The full involvement of all the DM is an integral and indispensable part of this project. For a comprehensive description of the project refer to the Terms of Reference already drawn up.

### 6.2 Agricultural water use

There are forty two irrigation boards within the Mpumalanga's area of jurisdiction. Nothing is known about their level of groundwater use. Not only does irrigation represent the largest water use sector in the RSA, but uncontrolled irrigation from groundwater poses an extremely high risk in terms of over-abstraction and other negative impacts. Refer to Figure 13 for the spatial distribution of the irrigation boards/WUA in the Mpumalanga Region and Appendix C contains a list of these organisations.

Figure 13: Spatial distribution of Irrigation Boards in Mpumalanga



In order to be able to prioritise any possible actions, i.e. incorporation of groundwater management into the water user association’s tasks, one needs to determine the level of groundwater use. The following steps are recommended: -

- Create software to evaluate the level of groundwater use (ToR already drawn up);
- Gather the required data and run the programme for each WUA/Irrigation Board;
- Prioritise the areas where groundwater management is needed the most urgently and implement management actions within these organisations.

Refer to the Terms of Reference for a project to develop and test a methodology and create the necessary software, to calculate the volume of water being abstracted for irrigation purposes.

## 6.3 Other groundwater-related issues

### 6.3.1 Groundwater management and protection

Through NORAD funding a set of guidelines has been developed to assist the local and district municipalities to manage their groundwater resources. These are: -

- Overview documentation;
- Descriptors;
- Groundwater protection;
- Maps;
- Software;

- Monitoring;
- Sustainability;
- Reference sites

Although the guidelines were written in such a way that any WSA, WSP and/or CMA should be able to implement them, it is envisaged that some assistance will be required and some resources will have to be allocated to ensure that the work is executed smoothly. It might even be necessary to actively engage these authorities in implementing these actions. The project to determine the level of dependence and volumes of groundwater used by rural settlements can be used to prioritise the implementation of groundwater management and protection actions.

### 6.3.2 Data management

A total lack of data management has been identified as one of the priorities. If this aspect is not addressed immediately, none of the above tasks and/or projects would be sustainable.

### 6.3.3 Groundwater Resources Assessment Phase II

This project had five components, which are a) Groundwater use, b) Classification, c) Groundwater/surface water interaction, d) Recharge and e) Planning potential. The scale of the project was at the national level although the calculations were done per quaternary catchment. The result is that data is of low resolution and of low confidence in area of low borehole coverage and/or inappropriate data.

In spite of this low confidence level the promotion of the results of this project is important as it fills a gap in our knowledge about groundwater. Most of the methodologies developed in this project can be used to improve the results by using local level data.

A project to test the methodology to calculate the surface water-groundwater interaction, in the light of the many rivers fed by groundwater, i.e. low flows during low rainfall (winter) periods, in Mpumalanga is strongly recommended.

In order to prioritise the tasks and functions as discussed in the previous text a table with tasks and its priority follows.

## 6.4 Prioritisation of identified tasks

**Table 2: Table of prioritised long-term tasks**

Task description	Actions	Priority
Survey of domestic groundwater use	The envisaged steps are: - 1. Identify rural settlements either wholly or largely dependent on groundwater for domestic supplies; 2. Choose project area preferably where surface water is being used as well; 3. Determine the level of groundwater use (devise methodology to calculate water use based on pump type and population figures); 4. Determine the exploitation potential of project area;	1

	<p>5. Calculate the value of groundwater taking into account the volumes of groundwater used, still available for use against the volume of surface water being used.</p> <p>Apply methodology to other settlements/area where groundwater is use wholly or largely for domestic water supplies.</p> <p>Draft ToR for project in progress.</p>	
Survey of agricultural groundwater use	<p>Envisaged steps are: -</p> <ol style="list-style-type: none"> <li>1. Identify all areas where irrigation is taking place;</li> <li>2. Choose well demarcated area and determine volumes for both surface and groundwater use;</li> <li>3. Test SAPWAT's capability to calculate same figures;</li> <li>4. Calculate the value of the contribution ground-water is making.</li> </ol> <p>Apply methodology to other areas under irrigation.</p> <p>Draft ToR for such a project has been drawn up.</p>	1
Extend the monitoring based on the outcomes of the above two projects	<ol style="list-style-type: none"> <li>1. Domestic water sector: - Start monitoring in areas where multi-sectorial users use a common source as this poses the highest potential conflict.</li> <li>2. Agricultural sector: - Start monitoring to in both potential impacted areas and pristine areas.</li> </ol> <p>Current staff could be used to execute geophysical surveys to identify the specific monitoring borehole sites once a general area has been chosen.</p>	2
Implement Data Acquisition Strategy	<p>The following steps are needed to implement this Strategy: -</p> <ol style="list-style-type: none"> <li>1. Identify all potential suppliers of groundwater data;</li> <li>2. Adapt the Strategy to reflect conditions in the Region.</li> <li>3. Implement Strategy.</li> </ol>	
Aquifer Protection	<p>The following steps are needed to implement this actions: -</p> <ol style="list-style-type: none"> <li>1. Identify all mines in the Region (use SGD to collect data).</li> <li>2. Determine the level of monitoring these mines are already doing.</li> <li>3. Determine the amount of data available and identify the steps necessary to capture the data.</li> <li>4. Start with the capturing of the borehole data onto the NGA first.</li> <li>5. Identify and train staff that can do the capturing of water quality data onto the WMS.</li> </ol>	

## 6.5 Proposed groundwater staff structure

The current staff component is woefully inadequate to cope with the proposed tasks and workload should this plan be accepted and implemented. The following structure is proposed: -

Deputy Director: Groundwater

2x Assistant Directors (1x Inkomati and 1x Olifants WMA)

4x Principle/senior/geohydrologist (2x Inkomati and 2x Olifants WMA)

4x Principle/senior/geotechnologist (2x Inkomati and 2x Olifants WMA)

2x Auxiliary Officers (Data management, 1x Chief or higher and one SAO)

2x Auxiliary Officers (field)

The following responsibilities are allocated to the following staff: -

- Deputy Director: Groundwater: Supervise, control the senior personnel and supply the strategic direction for groundwater in general and ensure that the groundwater plan is updated every six months.
- Assistant Directors: Manage the junior staff members and execute mainly office related tasks which inter alia include the work plans, synthesis of data to produce and update relevant groundwater information products in support of inter alia water quality management, the supervision of data management staff component and the finalisation of groundwater license applications (final approval at head Office).
- Geohydrologist/geotechnologist: a) Collection and collation of all relevant groundwater-related data which include inter alia research projects; b) activate groundwater management in district municipalities and/or irrigation boards/WUA; c) assist with the validation of water use registration and d) support to water quality management in terms of groundwater.

Alternatively the Deputy Director should supervise both the Mpumalanga and KwaZulu-Natal Region as part of the Eastern Cluster. The reasoning behind the post of assistant director is because of the large backlog in terms of knowledge of the occurrences and management of groundwater in relation to surface water although it plays a strategic, but largely unrecognised role in the water household of the Republic of South Africa.

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## APPENDIX A: DEFINITION OF THE WATER FUNCTIONS AS DEFINED IN THE NWA (1998) IN RELATION TO GROUNDWATER

### 1. INTRODUCTION

The functions as defined by the NWA (1998) are 'development', 'utilisation', 'protection', 'conservation' and 'management'. What was left out but underpins all these functions, is the data/information management. Data management must at all times forms an irrevocably part of these functions and will be discussed in the main text in this context.

In the following paragraphs these functions will be discussed in detail in order to create a common understanding of what is meant.

### 2. DEVELOPMENT

Groundwater in the South Africa, although it played an important role, was never brought into the planning stages right from the reconnaissance phase of any water supply project. The aim under this function would be to entrench groundwater into the planning processes from the Reconnaissance- through to the Feasibility Study phases with the concomitant funding of groundwater studies.

Issues under this heading relate to questions like: -

- 'Is there enough groundwater for development locally and what would it costs in relation to surface water supplies?'
- 'Can groundwater augment the surface water supplies, i.e. conjunctive use?'
- 'Why is groundwater not considered as a source of domestic water in a particular area?'
- 'Is there a potential for the further development of groundwater sources in a particular area?'
- 'Is there still some untapped groundwater sources that needs to be discovered?'

Guidelines for groundwater pre- and feasibility studies have been drawn up. These studies are mostly in the form of desk studies. However, a feasibility study could include exploration drilling in areas where not enough is known about groundwater occurrences and exploitation potential.

Most of these questions can be answered through the execution of reconnaissance and pre-feasibility studies. The aim of these studies is to put the decision to use groundwater or not, on the par with that of surface water. The 1:500 000 scale geohydrological maps can serve as inputs to the Reconnaissance and Pre-Feasibility phase studies. However, due a



lack of data in particular areas, and being a large-scale map, some generalisations had to be made on each Hydrogeological map. The guidelines for executing and implementing of groundwater feasibility studies address the shortcomings at both a local and regional scale.

Conceptual models of groundwater occurrences are important as well, as these might identify potential additional untapped aquifers.

### 3. UTILISATION

Is to ensure that where adequate groundwater resources are available, it is not neglected in favour of more expensive surface water schemes due to lack of an understanding of the role groundwater can play, or due to cultural issues. A case in point is the Van Rhynsdorp Municipality who, in spite of the fact that ample groundwater sources were available, insisted they be supplied from surface water sources.

Issues under this heading relates to questions like; -

- 'To what extent are the available groundwater resources being utilised to its full potential?'
- 'To what extent is a particular aquifer over abstracted?'
- 'What opportunities are there to utilise available groundwater and surface water conjunctively?'

With aquifer management in place and supported by sound data management practices, most of the above questions can be answered. Other aspects like the execution of groundwater feasibility studies and mathematical modelling can assist in answering some of the questions posed above. The NWA (1998) of the RSA demands judicious use of the available source, whether ground- or surface water, as we live in a water scarce country.

Furthermore, in the utilisation of groundwater one must guard against the perception that groundwater and surface water are two separate sources. The hydrological cycle is a unit and double counting of the resources can lead to problems in the future. A case in point is the mined-out areas on the Highveld. The mining industry has proposed to tap flooded mines and claim that it 'new' water. Only in cases where excess run-off (high-flow periods or floods) is used to recharge depleted mine-water, can it be seen as a saving of 'lost' waters. This particular area is underlain by shale of the Ecca Formation, which has a rather low

groundwater potential and conditions to enhance recharge will have to be created to establish a viable source. In the case of artificially induced recharge run-off will be affected.

## 4. PROTECTION

Protection is about save-guarding the groundwater resources of this country against pollution and over-abstraction and the aquatic-ecosystems. The aim is to maintain the quality of the water for domestic, aquatic ecosystems and agricultural, industrial and commercial use. Bredenhan and Braune (2000) equate the level of protection to the value of aquifer being protected and an aquifer classification system was thus devised by Parsons(1998).

Issues under this heading relate to questions like: -

- 'How valuable is a particular aquifer or aquifer system?'
- 'Against what must this aquifer be protected?'
- 'For what purpose must this aquifer be protected?'

It is a well-known fact that the coal mining industry is polluting surface water sources (acid mine drainage) but the extent of groundwater pollution on the Highveld still needs to be quantified. A starting point would be to draw up a coherent list of mines and industries and identify the pollution- potential of these industries also showing which f the industries are doing any monitoring and what are the monitoring ; i.e. abstraction, water level fluctuations and/or water quality.

The function of groundwater protections has very strong ties with the Water Quality Management function and the links between the department's National Groundwater Archive and Water Management System must be promoted actively.

## 5. CONSERVATION

Is about the long-term view of the availability of resources for the future generations. The water resources of the RSA need to be conserved for the next generations and is well encapsulated in the logo 'Some for all, forever'. In this regard the main issue would be the establishment of a water conservation culture through the e3ntrenchment of demand management practices at local and district municipal level and within WUAs. Conservation is not unique to groundwater, for example the SA Parks has been involved in conservation of the fauna and flora of the RSA for more that a century.

Conservation offers us all the best possible opportunity to co-operate in different spheres like nature conservation with multiple purposes; thus a multidisciplinary approach. A case in hand is the Mpumalanga Plateau where restrictions on the extension of plantations can safeguard, not only unique habitats, but also the groundwater sources that feed perennial rivers.

## 6. MANAGEMENT

To be able management one must measure. Generically the aspects to be measured can be defined as inputs, outputs and changes to the system due the aforementioned two. For groundwater these translates to recharge, abstraction (natural and artificial) and water level fluctuations.

The biggest obstacle to the management of the groundwater resources of the Mpumalanga Region and to greater or lesser extent for the whole of the RSA, is the fact that very little is known about who is abstracting where and how much. The biggest priority in this regard thus is to determine where, by whom and how much groundwater are being abstracted, i.e. quantifying the groundwater use. Only then can coherent and systematic groundwater monitoring programmes be devised.

Issues under this heading relate to questions like: -

- 'How much groundwater are the irrigation farmers using?'
- 'Is the mining industry using any groundwater?'
- 'Do the mines pump out excess groundwater and do the dispose this water?'
- 'Do the mines who abstract groundwater affect the surrounding farmers at all?'

To be able to identify any possible negative impacts within areas of groundwater use, the behaviour of the natural system needs to be characterised. From this it is clear that different levels of monitoring are needed. Monitoring the natural conditions not only help to determine baseline conditions from which recharge can be calculated, but also can assist to evaluate and quantify the effects of changing weather patterns.

Fortunately the NWA (1998) has supplied the necessary instruments to assist the department in its management functions - these being Water Users Associations. The aim of the Act is to devolve the management of a source down to the lowest possible level, i.e. the users tapping a common source like an aquifer and being mutually dependent of this particular source. The challenge would be to convince these users to the value of this source and the necessity to manage it for the benefit of the whole group.

## 7. DATA/INFORMATION MANAGEMENT

Broken down into the smallest possible denominators, data is about the acquisition, capturing and dissemination of data and information to support the strategic and operational decisions of the department in order to fulfil its mission and objectives.

Without active data and information management in place, none of the above endeavours will come to fruition.

For a more detailed explanation of good data management practices, refer to Appendix B.

## APPENDIX B: GOOD DATA MANAGEMENT PRACTICES

### 1. INTRODUCTION

Data collection must be managed as part of a value chain. This chain starts with a) *data* from which b) *information* is generated and based on this information c) *knowledge* and insight is acquired to resolve questions in support of d) *strategic and/or operational decisions*, which should support the organisation's e) *mission and objectives*. The mission and objectives of an organisation clearly provide a long-term focus and the data collection has a short-term focus.

### 2. DATA MANAGEMENT WITHIN AN ORGANISATION

To be able to manage data an organisation needs a) people, b) services, c) facilities, d) technologies, e) applications and last but not the least f) data. A set of questions one has to ask oneself, in order to test whether I am managing my data well, is: -

- What a, b, c, d, e & f do I have?
- Where do I have my a, b, c, d, e & f?
- How well does my a, b, c, d, e & f work in support of my organisation's mission and objectives?
- How much does my a, b, c, d, e & f costs?

The following two mission statements of the DWAF contain issues related to data management issue. These are: -

- **Conserving, managing and developing our water resources and forests in a scientific and environmentally sustainable manner in order to meet the social and economic needs of South Africa, both now and in the future; and**
- **Educating the people of South Africa on ways to manage, conserve and sustain our water and forest resources;**

The objectives for the DWAF were drawn from the National Water resources Strategy. These are: -

### 3. SITUATIONAL ANALYSIS

In an attempt to evaluate the performance and highlight priority action areas, a data management matrix, based on the described elements and proposed questions, has been drawn up. This is shown in table 1.

**Table 3: DATA MANAGEMENT MATRIX**

	People	Services	Facilities	Technologies	Applications	Data
What	1		3	3	3	1
Where	1		3		2	1
How well	1				3	1
Total:	3				8	3

Scoring method: -

People ≡ None= 1, coping = 2, adequate = 3;

Services ≡ None= 1, coping = 2, adequate = 3;

Facilities ≡ None= 1, coping = 2, adequate = 3;

Technologies ≡ None= 1, coping = 2, adequate = 3;

Applications ≡ None= 1, coping = 2, adequate = 3;

Data ≡ None= 1, coping = 2, adequate = 3;

## 4. SUMMARY

The lack of groundwater data and data capturing staff is the two priority areas of concern.

## 5. CONCLUSIONS

To effectively manage data, a dedicated data group of staff members needs to be established together with a dedicated supervisor. However, to motivate a dedicated supervisor for such a group, they must consist of at least five to six persons. The benefits of such a large group is that they can serve the data capturing needs of all the systems, e.g. WMS, NGA and WARMS at the same time.

Furthermore, a well-managed archive of the original data, whether in paper or electronic format, is a prerequisite.

**APPENDIX C: LIST OF IRRIGATION BOARDS IN THE MPUMALANGA**

**1. INKOMATI WATER MANAGEMENT AREA**

<b>BURGERSHALL BESPROEIINGSRAAD (?)</b>		<b>BR 7/1/30</b>	<b>WGV 7/18/33</b>	
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	D.J. Diedericks	
POSADRES	243	POSADRES	213	
POSTAL ADDRESS:	White River	POSTAL ADDRESS:	Kiepersol	
	1240		1241	
TELEFOON / TELEPHONE NO:	(013) 751 2245	TELEFOON / TELEPHONE NO:	(013) 737 8914	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	082 821 0077	
FAKS / FAX NO:	(013) 750 0729	FAKS / FAX NO:	(013) 737 8914	
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL		

<b>CURLEWS BESPROEIINGSRAAD (?)</b>		<b>BR 7/1/211</b>	<b>WGV 7/18/35</b>	
SEKRETARIS / SECRETARY :	H.C. Hopkins	VOORSITTER / CHAIRMAN :	J.S. Marais	
POSADRES	3452	POSADRES	3427	
POSTAL ADDRESS:	White River	POSTAL ADDRESS:	White River	
	1240		1240	
TELEFOON / TELEPHONE NO:	(013) 751 3017	TELEFOON / TELEPHONE NO:	(013) 750 0455	
SELFOON / CELL PHONE:	082 461	SELFOON / CELL PHONE:		
FAKS / FAX NO:	(013) 751 3017	FAKS / FAX NO:	(013) 750 0455	
E-POS / E-MAIL		E-POS / E-MAIL		

<b>DE RUST BESPROEIINGSRAAD (?)</b>		<b>BR 7/1/80</b>	<b>WGV 7/18/36</b>	
SEKRETARIS / SECRETARY :	Dr G. Haarhoff	VOORSITTER / CHAIRMAN :	F. Lourens	
POSADRES	361	POSADRES	1677	
POSTAL ADDRESS:	Hazyview	POSTAL ADDRESS:	Hazyview	
	1242		1242	
TELEFOON / TELEPHONE NO:	(013) 737 7065	TELEFOON / TELEPHONE NO:	(013) 737 7636	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	082 820 5121	
FAKS / FAX NO:	(013) 737 7725	FAKS / FAX NO:	(013) 737 7629	
E-POS / E-MAIL		E-POS / E-MAIL		

<b>ELANDS VALLEI BESPROEIINGSRAAD (28)</b>		<b>BR 7/1/212</b>	<b>WGV 7/18/37</b>	
SEKRETARIS / SECRETARY :	S Wreyford	VOORSITTER / CHAIRMAN :	H. Naumann	
POSADRES	129	POSADRES	78	
POSTAL ADDRESS:	Ngodwana	POSTAL ADDRESS:	Ngodwana	
	1209		1209	
TELEFOON / TELEPHONE NO:	(013) 734 4706	TELEFOON / TELEPHONE NO:	(013) 734 4407	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	082 789 5936	
FAKS / FAX NO:	(013) 734 4820	FAKS / FAX NO:	(013) 734 4820	
E-POS / E-MAIL		E-POS / E-MAIL		

<b>EUREKA BESPROEINGSRAAD (40)</b>		<b>BR 7/1/166</b>	<b>WGV 7/18/38</b>
SEKRETARIS / SECRETARY :	Ms R. Putter	VOORSITTER / CHAIRMAN :	G.F. Engelbrecht
POSADRES	382	POSADRES	96
POSTAL ADDRESS:	Malelane 1320	POSTAL ADDRESS:	Lows Creek 1302
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 744 7790
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	083 303 1300
FAKS / FAX NO:	(013) 790 1233	FAKS / FAX NO:	(013) 744 7180
E-POS / E-MAIL	Ronelle.putter@lantic.net	E-POS / E-MAIL	

<b>FRIEDENHEIM BESPROEINGSRAAD (39)</b>		<b>BR 7/1/167</b>	<b>WGV 7/18/39</b>
SEKRETARIS / SECRETARY :	Wegner Maritz & Venote	VOORSITTER / CHAIRMAN :	S.A. de Kok
POSADRES	358	POSADRES	358
POSTAL ADDRESS:	Nelspruit 1200	POSTAL ADDRESS:	Nelspruit 1200
TELEFOON / TELEPHONE NO:	(013) 755 2246	TELEFOON / TELEPHONE NO:	(013) 758 1413
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:	(013) 753 2568	FAKS / FAX NO:	(013) 758 1413
E-POS / E-MAIL		E-POS / E-MAIL	

<b>GOOD HOPE BESPROEINGSRAAD (?)</b>		<b>BR 7/1/168</b>	<b>WGV 7/18/40</b>
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	M. Bosch
POSADRES	243	POSADRES	20
POSTAL ADDRESS:	White River 1240	POSTAL ADDRESS:	Karino 1204
TELEFOON / TELEPHONE NO:	(013) 751 2245	TELEFOON / TELEPHONE NO:	(013) 747 2195
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:	(013) 750 0729	FAKS / FAX NO:	
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL	

<b>KAALRUG BESPROEINGSRAAD (33)</b>		<b>BR 7/1/169</b>	<b>WGV 7/18/42</b>
SEKRETARIS / SECRETARY :	Ms R. Putter	VOORSITTER / CHAIRMAN :	D van Rooy
POSADRES	382	POSADRES	47
POSTAL ADDRESS:	Malelane 1320	POSTAL ADDRESS:	Malelane 1320
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 791 1004
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	082 570 7069
FAKS / FAX NO:	(013) 790 1233	FAKS / FAX NO:	(013) 791 1193
E-POS / E-MAIL	ronelle.putter@lantic.net	E-POS / E-MAIL	vrooyd@tsb.co.za

<b>KAAPRIEVERALLEI HOOFBESPROEINGSRAAD</b>		<b>BR 7/1/419</b>	<b>WGV 7/18/43</b>
SEKRETARIS / SECRETARY :	Ms R. Putter	VOORSITTER / CHAIRMAN :	C.J.H. du Preez
POSADRES	382	POSADRES	22
POSTAL ADDRESS:	Malelane 1320	POSTAL ADDRESS:	Barberton 1300
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 712 6260
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	083 253 9656
FAKS / FAX NO:	(013) 790 1233	FAKS / FAX NO:	(013) 712 5870
E-POS / E-MAIL	ronelle.putter@lantic.net	E-POS / E-MAIL	casdupreez@soft.co.za



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<b>KOMATI BESPROEIINGSRAAD (31)</b>		<b>BR 7/1/117</b>	<b>WGV 7/18/44</b>
SEKRETARIS / SECRETARY :	Ms R. Putter	VOORSITTER / CHAIRMAN :	R.V. Gordon
POSADRES	382	POSADRES	103
POSTAL ADDRESS:	Malelane 1320	POSTAL ADDRESS:	Hectorspruit 1330
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 792 4389
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	082 805 3813
FAKS / FAX NO:	(013) 790 1233	FAKS / FAX NO:	(013) 792 4389
E-POS / E-MAIL	ronelle.putter@lantic.net	E-POS / E-MAIL	

<b>KROKODIL BESPROEIINGSRAAD (?)</b>		<b>BR 7/1/24</b>	<b>WGV 7/18/34</b>
SEKRETARIS / SECRETARY :	Ms R. Putter	VOORSITTER / CHAIRMAN :	D van Rooy
POSADRES	382	POSADRES	47
POSTAL ADDRESS:	Malelane	POSTAL ADDRESS:	Malelane
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 791 1004
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	082 570 7069
FAKS / FAX NO:	(013) 790 1233	FAKS / FAX NO:	(013) 791 1193
E-POS / E-MAIL	ronelle.putter@lantic.net	E-POS / E-MAIL	vrooyd@tsb.co.za

<b>LAER KAAP BESPROEIINGSRAAD (36)</b>		<b>BR 7/1/170</b>	<b>WGV 7/18/46</b>
SEKRETARIS / SECRETARY :	Ms R. Putter	VOORSITTER / CHAIRMAN :	G.S. van Niekerk
POSADRES	382	POSADRES	3
POSTAL ADDRESS:	Malelane 1320	POSTAL ADDRESS:	Kaapmuiden 1295
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 726 0198
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	083 251 8239
FAKS / FAX NO:	(013) 790 1233	FAKS / FAX NO:	(013) 726 0045
E-POS / E-MAIL	ronelle.putter@lantic.net	E-POS / E-MAIL	

<b>LOMATI BESPROEIINGSRAAD (32)</b>		<b>BR 7/1/213</b>	<b>WGV 7/18/45</b>
SEKRETARIS / SECRETARY :	W du Toit	VOORSITTER / CHAIRMAN :	P. W. De Wet
POSADRES	1402	POSADRES	1308
POSTAL ADDRESS:	Malelane 1320	POSTAL ADDRESS:	Malelane 1320
TELEFOON / TELEPHONE NO:	(013) 781 0319	TELEFOON / TELEPHONE NO:	(013) 792 4415
SELFOON / CELL PHONE:	082 396 1680	SELFOON / CELL PHONE:	082 776 3654
FAKS / FAX NO:	(013) 781 0320	FAKS / FAX NO:	(013) 792 4416
E-POS / E-MAIL	dutoitw@mweb.co.za	E-POS / E-MAIL	p3dewet@mweb.co.za

<b>LOUWS CREEK BESPROEIINGSRAAD (35)</b>		<b>BR 7/1/171</b>	<b>WGV 7/18/47</b>
SEKRETARIS / SECRETARY :	J. Deuhrmann	VOORSITTER / CHAIRMAN :	C.J. Claasen
POSADRES	76	POSADRES	76
POSTAL ADDRESS:	Lows Creek 1302	POSTAL ADDRESS:	Lows Creek 1302
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	(013) 710 0047
SELFOON / CELL PHONE:	082 673 9008	SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	(013) 710 0290
E-POS / E-MAIL		E-POS / E-MAIL	

<b>MALELANE BESPROEINGSRAAD (38)</b>		<b>BR 7/1/172</b>		<b>WGV 7/18/48</b>	
SEKRETARIS / SECRETARY :	Ms R. Putter	VOORSITTER / CHAIRMAN :	C.G van Veyeren		
POSADRES	382	POSADRES	345		
POSTAL ADDRESS:	Malelane	POSTAL ADDRESS:	Malelane		
	1320		1320		
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 790 0745		
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	083 255 9904		
FAKS / FAX NO:	(013) 790 1233	FAKS / FAX NO:	(013) 790 0590		
E-POS / E-MAIL	ronelle.putter@lantic.net	E-POS / E-MAIL			

<b>MANCHESTER BESPROEINGSRAAD (?)</b>		<b>BR 7/1/164</b>		<b>WGV 7/18/60</b>	
SEKRETARIS / SECRETARY :	W. Smuts	VOORSITTER / CHAIRMAN :	F.D.V. Kok		
POSADRES	39	POSADRES	198		
POSTAL ADDRESS:	Karino	POSTAL ADDRESS:	Karino		
	1204		1204		
TELEFOON / TELEPHONE NO:	(013) 747 2101	TELEFOON / TELEPHONE NO:	(013) 747 2264		
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:			
FAKS / FAX NO:	(013) 747 2114	FAKS / FAX NO:	(013) 747 2005		
E-POS / E-MAIL		E-POS / E-MAIL			

<b>NOORDKAAPRIEVER BESPROEINGSRAAD (34)</b>		<b>BR 7/1/173</b>		<b>WGV 7/18/50</b>	
SEKRETARIS / SECRETARY :	M.Smith	VOORSITTER / CHAIRMAN :	C.J.H. du Preez		
POSADRES	22	POSADRES	22		
POSTAL ADDRESS:	Barberton	POSTAL ADDRESS:	Barberton		
	1300		1300		
TELEFOON / TELEPHONE NO:	(013) 712 6260	TELEFOON / TELEPHONE NO:	(013) 712 6260		
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	083 253 9656		
FAKS / FAX NO:	(013) 712 5870	FAKS / FAX NO:	(013) 712 5870		
E-POS / E-MAIL		E-POS / E-MAIL	casdupreez@soft.co.za		

<b>QUEENSRIVIER BESPROEINGSRAAD (42)</b>		<b>BR 7/1/174</b>		<b>WGV 7/18/51</b>	
SEKRETARIS / SECRETARY :	M.Smith	VOORSITTER / CHAIRMAN :	C.J.H. du Preez		
POSADRES	22	POSADRES	22		
POSTAL ADDRESS:	Barberton	POSTAL ADDRESS:	Barberton		
	1300		1300		
TELEFOON / TELEPHONE NO:	(013) 712 6260	TELEFOON / TELEPHONE NO:	(013) 712 6260		
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	083 253 9656		
FAKS / FAX NO:	(013) 712 5870	FAKS / FAX NO:	(013) 712 5870		
E-POS / E-MAIL		E-POS / E-MAIL	casdupreez@soft.co.za		

<b>RANCH KARINO BESPROEINGSRAAD (?)</b>		<b>BR 7/1/175</b>		<b>WGV 7/18/52</b>	
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	D.S.van Staaden		
POSADRES	243	POSADRES	1177		
POSTAL ADDRESS:	White River	POSTAL ADDRESS:	White River		
	1240		1240		
TELEFOON / TELEPHONE NO:	(013) 751 2245	TELEFOON / TELEPHONE NO:	(013) 751 1847		
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	083 290 1438		

FAKS / FAX NO:	(013) 75 00729	FAKS / FAX NO:	(013) 751 1995
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL	

<b>SABIERIVIER BESPROEINGSRAAD (1)</b>		<b>BR 7/1/116</b>		<b>WGV 7/18/53</b>	
SEKRETARIS / SECRETARY :	M. Visser	VOORSITTER / CHAIRMAN :	A. Kerslake		
POSADRES	158	POSADRES	158		
POSTAL ADDRESS:	Hazyview	POSTAL ADDRESS:	Hazyview		
	1242		1242		
TELEFOON / TELEPHONE NO:	(013) 737 8121	TELEFOON / TELEPHONE NO:	(013) 737 8183		
SELFOON / CELL PHONE:	082 430 9576	SELFOON / CELL PHONE:	082 869 1416		
FAKS / FAX NO:	(013) 737 8121	FAKS / FAX NO:	(013) 737 8183		
E-POS / E-MAIL	srwua@soft.co.za	E-POS / E-MAIL			

<b>SANDRIVIER BESPROEINGSRAAD (27)</b>		<b>BR 7/1/176</b>		<b>WGV 7/18/54</b>	
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	J.M. Macregor		
POSADRES	243	POSADRES	186		
POSTAL ADDRESS:	White River	POSTAL ADDRESS:	White River		
	1240		1240		
TELEFOON / TELEPHONE NO:	(013) 751 2245	TELEFOON / TELEPHONE NO:	(013) 751 2711		
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	082 335 4444		
FAKS / FAX NO:	(013) 750 0729	FAKS / FAX NO:			
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL			

<b>SUIDKAAPRIVIER BESPROEINGSRAAD (41)</b>		<b>BR 7/1/177</b>		<b>WGV 7/18/55</b>	
SEKRETARIS / SECRETARY :	M.Smith	VOORSITTER / CHAIRMAN :	C.J.H. du Preez		
POSADRES	22	POSADRES	22		
POSTAL ADDRESS:	Barberton	POSTAL ADDRESS:	Barberton		
	1300		1300		
TELEFOON / TELEPHONE NO:	(013) 712 6260	TELEFOON / TELEPHONE NO:	(013) 712 6260		
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	083 253 9656		
FAKS / FAX NO:	(013) 712 5870	FAKS / FAX NO:	(013) 712 5870		
E-POS / E-MAIL		E-POS / E-MAIL	casdupreez@soft.co.za		

<b>TENBOSCH BESPROEINGSRAAD (37)</b>		<b>BR 7/1/178</b>		<b>WGV 7/18/56</b>	
SEKRETARIS / SECRETARY :	G. Kuhn	VOORSITTER / CHAIRMAN :	P. Maritz		
POSADRES	304	POSADRES	26		
POSTAL ADDRESS:	Komatipoort	POSTAL ADDRESS:	Hectorspruit		
	1340		1330		
TELEFOON / TELEPHONE NO:	(013) 793 7769	TELEFOON / TELEPHONE NO:	(013) 790 4386		
SELFOON / CELL PHONE:	082 855 3476	SELFOON / CELL PHONE:	083 228 0690		
FAKS / FAX NO:	(013) 793 7769	FAKS / FAX NO:	(013) 790 4386		
E-POS / E-MAIL	<a href="mailto:gskuhn@planetpastel.com">gskuhn@planetpastel.com</a>	E-POS / E-MAIL			

<b>W.R. ESTATES IRRIGATION BOARD (?)</b>		<b>BR 7/1/179</b>	<b>WGV 7/18/57</b>
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	Dr. C Pentz
POSADRES	243	POSADRES	489
POSTAL ADDRESS:	White River 1240	POSTAL ADDRESS:	White River 1240
TELEFOON / TELEPHONE NO:	(013) 75 12245	TELEFOON / TELEPHONE NO:	(013) 751 2461
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:	(013) 750 0729	FAKS / FAX NO:	(013) 751 2461
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL	

<b>W.R.V. CONSERVATION BOARD (13)</b>		<b>BR 7/1/215</b>	<b>WGV 7/18/58</b>
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	Dr. C Pentz
POSADRES	243	POSADRES	489
POSTAL ADDRESS:	White River 1240	POSTAL ADDRESS:	White River 1240
TELEFOON / TELEPHONE NO:	(013) 751 2245	TELEFOON / TELEPHONE NO:	(013) 751 2461
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:	(013) 75 00729	FAKS / FAX NO:	(013) 751 2461
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL	

<b>WHITE WATERS MAJOR IRRIGATION BOARD (30)</b>		<b>BR 7/1/30</b>	<b>WGV 7/18/59</b>
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	J. Koekemoer
POSADRES	243	POSADRES	2
POSTAL ADDRESS:	White River 1240	POSTAL ADDRESS:	Kiepersol 1241
TELEFOON / TELEPHONE NO:	(013) 751 2245	TELEFOON / TELEPHONE NO:	(013) 737 8965
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	082 462 2652
FAKS / FAX NO:	(013) 750 0729	FAKS / FAX NO:	
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL	

<b>Carolina GWCA</b>			
SEKRETARIS / SECRETARY:		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

<b>Crocodile River GWCA</b>			
SEKRETARIS / SECRETARY:	Mrs R Putter	VOORSITTER / CHAIRMAN :	CG van Veijeren
POSADRES	PO Box 382	POSADRES	PO Box 345
POSTAL ADDRESS:	Malelane 1320	POSTAL ADDRESS:	Malelane 1320
TELEFOON / TELEPHONE NO:	(013) 790 0591	TELEFOON / TELEPHONE NO:	(013) 790 0745
SELFOON / CELL PHONE:	083 274 1166	SELFOON / CELL PHONE:	083 255 9904
FAKS / FAX NO:	(013) 790 0231	FAKS / FAX NO:	(013) 790 0590

E-POS / E-MAIL		E-POS / E-MAIL	

## Injaka GWCA

SEKRETARIS / SECRETARY:		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

## Komati River GWCA

SEKRETARIS / SECRETARY:		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

## Selati IB

SEKRETARIS / SECRETARY:		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

## Upper Komati GWCA

SEKRETARIS / SECRETARY:		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

## 2. OLIFANTS WATER MANAGEMENT AREA

<b>GROOT DWARSRIVIER (25)</b>		<b>BR</b>	<b>WGV</b>
			7/18/41
SEKRETARIS / SECRETARY :	H.H. Deeks	VOORSITTER / CHAIRMAN :	D.J. Cloete
POSADRES	243	POSADRES	101900
POSTAL ADDRESS:	White River	POSTAL ADDRESS:	Meerensee
	1240		3901
TELEFOON / TELEPHONE NO:	(013) 751 2245	TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	082 779 0349
FAKS / FAX NO:	(013) 750 0729	FAKS / FAX NO:	(035) 908 8862
E-POS / E-MAIL	deehall@mweb.co.za	E-POS / E-MAIL	

<b>Blyde River GWCA (16)</b>		<b>BR</b>	<b>WGV</b>
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

<b>Blyde Irrigation Board (26)</b>		<b>BR</b>	<b>WGV</b>
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

<b>Kaspersnek-Vyehoek IB (5)</b>		<b>BR</b>	<b>WGV</b>
SEKRETARIS / SECRETARY :	S.M. Schulze	VOORSITTER / CHAIRMAN :	L.E. Schulze
POSADRES	P.O. Box 45	POSADRES	P.O. Box 106
POSTAL ADDRESS:	Ohrigstad	POSTAL ADDRESS:	Ohrigstad
	1122		1122
TELEFOON / TELEPHONE NO:	(01323) 80407 (01323) 80156	TELEFOON / TELEPHONE NO:	(01323) 80354
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Klasserie IB (23)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Laer Spekboom IB (4)		BR	WGV
SEKRETARIS / SECRETARY :	HE Nel	VOORSITTER / CHAIRMAN :	SIW Joubert
POSADRES	PO Box 256	POSADRES	PO Box 23
POSTAL ADDRESS:	Lydenburg	POSTAL ADDRESS:	Burgersfort
	1120		1150
TELEFOON / TELEPHONE NO:	(01323) 2151	TELEFOON / TELEPHONE NO:	(01323) 7880
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:	(01323) 4524	FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Laersdrift IB (17)		BR	WGV
SEKRETARIS / SECRETARY :	Die Sekretaresse	VOORSITTER / CHAIRMAN :	CJ Claasen
POSADRES	PO Box 76	POSADRES	PO Box 76
POSTAL ADDRESS:	Louw's Creek	POSTAL ADDRESS:	Louw's Creek
	1302		1302
TELEFOON / TELEPHONE NO:	N/A	TELEFOON / TELEPHONE NO:	(013) 710 0047
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	(013) 710 0290
E-POS / E-MAIL		E-POS / E-MAIL	

Loskop GWCA (15)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Loskop GWCA Extension (14)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	

SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Mapochsgronde GWCA (12)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Ohrigstad GWCA (11)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Olifants River (Lowveld) GWCA (10)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Phalaborwa GWCA (9)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	



Rust de Winter GWCA (8)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Sekoekoenieland GWCA (7)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Spekboom IB (2)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Steelpoort River IB (3)		BR	WGV
SEKRETARIS / SECRETARY :		VOORSITTER / CHAIRMAN :	
POSADRES		POSADRES	
POSTAL ADDRESS:		POSTAL ADDRESS:	
TELEFOON / TELEPHONE NO:		TELEFOON / TELEPHONE NO:	
SELFOON / CELL PHONE:		SELFOON / CELL PHONE:	
FAKS / FAX NO:		FAKS / FAX NO:	
E-POS / E-MAIL		E-POS / E-MAIL	

Watervals River GWCA (6)		BR	WGV
SEKRETARIS / SECRETARY :	Mr S Treurnicht	VOORSITTER / CHAIRMAN :	Mr L Lotter
POSADRES	PO Box 66	POSADRES	PO Box 357
POSTAL ADDRESS:	Burgersfort	POSTAL ADDRESS:	Burgersfort
	1150		1150
TELEFOON / TELEPHONE NO:	(013) 231 7674	TELEFOON / TELEPHONE NO:	(013) 231 7834
SELFOON / CELL PHONE:	082 374 9109	SELFOON / CELL PHONE:	
FAKS / FAX NO:	(013) 231 7674	FAKS / FAX NO:	Ask for fax
E-POS / E-MAIL		E-POS / E-MAIL	

# Mpumalanga Groundwater Master Plan

## DOCUMENT HISTORY AND CONTROL

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DOCUMENT HISTORY					
NUMBER OF LAST CHANGE REQUEST INCLUDED	COMMENTS	PAGE NUMBERS OF PAGES CHANGED FOR AMENDMENTS	VERSION	DATE	PRODUCER
0	First Draft		One	2006/03/02	WE Bertram

DOCUMENT ACCEPTANCE			
Role	Name	Signature	Date
Producer	WE Bertram		2006-03-02
Accepted by	Kheva Silo		2008-05-30
Project Leader/Sponsor	J. Van Aswegen		2008-05-30