DEPARTMENT: WATER AFFAIRS AND FORESTRY

KwaZulu-Natal Groundwater Plan

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1. INTRODUCTION

This document will serve as a master plan to be used by KwaZulu-Natal'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 defined in the NWA (1998), in relation to groundwater is found in Appendix A. The different geohydrological regions (Vegter-regions) will be discussed and where possible, any groundwater activities identified and actions needed to execute these functions proposed.

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 as well as 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.

1.1 Purpose

The purpose of this document is to assist the management cadre in the KwaZulu-Natal 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 addressing all water functions as defined by National Water Act (1998) for the KwaZulu-Natal 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 projects might have on the improvement of the execution of the functions must be addressed as well.

1.3 Audience

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

1.4 Revision

As this version (Version 1) of this document is only a draft, to kick start the required groundwater functions, it is strongly recommended that it is revised and adapted every six months in close conjunction with the KwaZulu-Natal Region's management structure.

As more details become 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
1.1 Usutu to Mhlatuze.
1.2 Thukela and
1.3 Mvoti to Umzimkul Water Management Areas.
2. National Water Resources Strategy
3. Groundwater Resources Strategy

1.6 Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ISP	Internal Strategic Perspective
WMA	Water Management Area
Open-NGDB	National Groundwater Database running on an open server
KNP	Kruger National Park
WMS	Water Management System (chemical database)
SGD	Standard Geosite Descriptors
NGA	National Groundwater Archive (used to capture all groundwater-related data) which will be replacing the Open-NGDB soon.
D:WQM	Directorate: Water Quality Management

2. WATER FUNCTIONS AS PER NWA IN KWAZULU-NATAL

2.1 Introduction

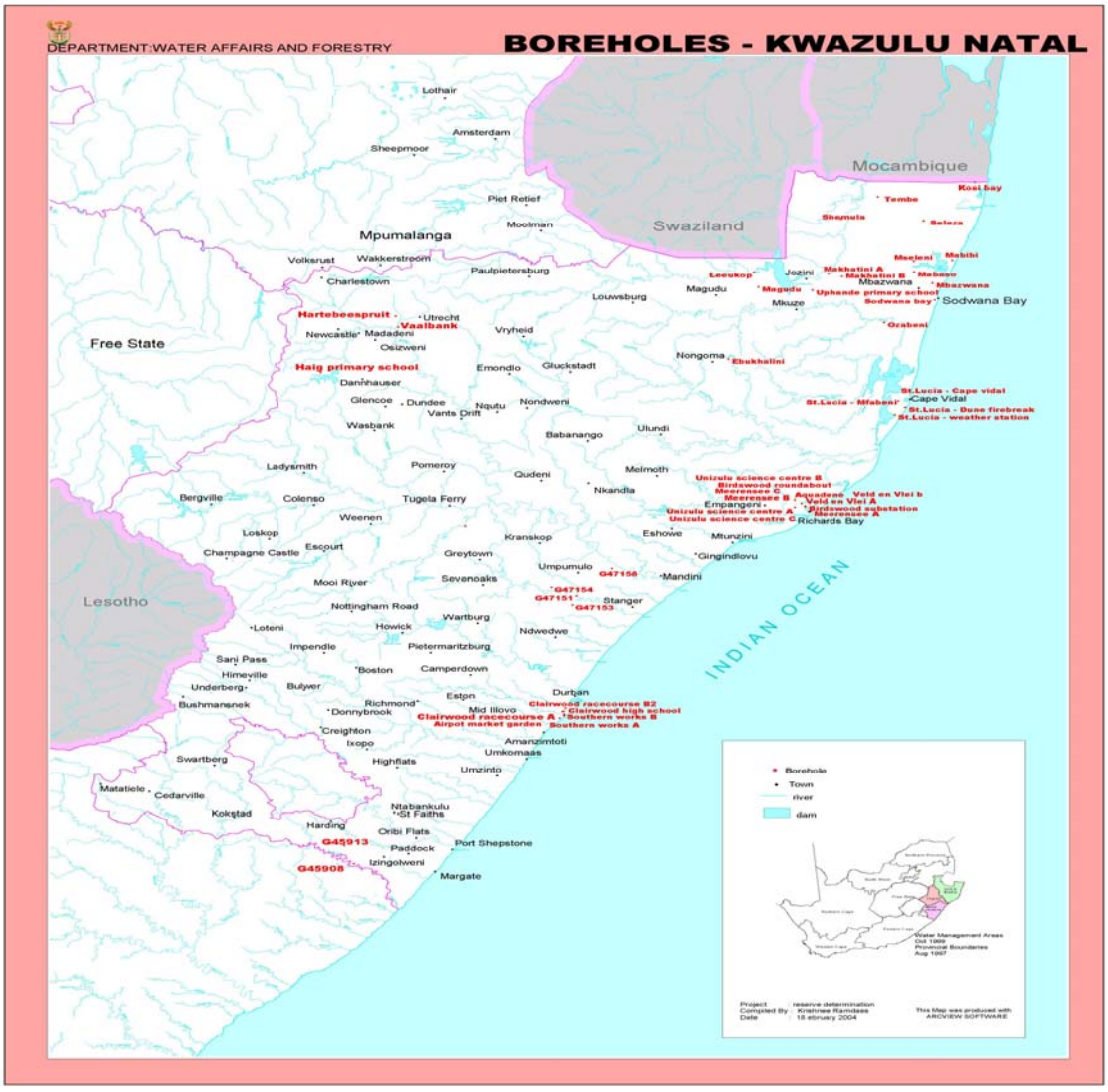
The water functions as identified in the NWA (1998) are the following: - i) development, ii) utilisation, iii) protection, iv) conservation and v) management. In order to create a common understanding of these terms, a comprehensive discussion about them and the tasks related to these water functions, 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).

Figure 1: Spatial distribution of existing water level monitoring points



About 48 groundwater points are currently being monitored actively for water level fluctuations and/or chemical parameters. The spatial distribution of these points is very uneven and mostly covers the northern and southern most portions of the KwaZulu-Natal Region (See 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 to be launched immediately.

The inadequacy of the groundwater monitoring network has been worsened by a very high staff turn over which caused discontinuity in projects aimed at expanding the network, and also contributed to the loss of crucial information on the reason for establishment of some of the monitoring sites. This stresses the need to launch a project aimed at establishing the value and the reasons for placement of the monitoring points.

There are about 8 points where chemical monitoring is being done on a six-monthly basis. In terms of the envisaged plan, there should be between three and five of monitoring points per hydrogeological region.

It is only in a few areas within the KwaZulu-Natal Region where abstraction is being undertaken. Critical areas would have to be identified and made a first priority for monitoring.

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

Monthly water level data collected from the monitoring points mentioned above are processed and captured on Hydstra. Eight of these monitoring points are used for quality monitoring and are therefore equipped with electronic data logging devices. Data from the data loggers is downloaded at a frequency once in three months and data is currently captured on Hydrus III. This data will be transferred into Hydstra once the link between HydrusIII and Hydstra has been established.

For a comprehensive discussion on the data capturing functions refer to Appendix A. Additional guidelines and information on data management can be gained from the ‘Groundwater Data Acquisition and Capturing Strategy’.

3. GEOHYDROLOGICAL REGIONS

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 poses potential risks to the groundwater sources will be discussed together with the aquifer properties and potential monitoring actions which could be implemented very soon.

3.1 Introduction

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

Five Vegter-regions falls largely or wholly within the KwaZulu-Natal Province. These are the **Southern Lebombo**, **Northern Zululand Coastal Plain**, **Northeastern Middleveld**, **Northwestern Middleveld** and **KwaZulu-Natal Coastal Foreland**. Two fall only partially within this province and are **Transkeian Coastal Foreland** & **Middleveld and Eastern Highveld**.

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 scarce 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

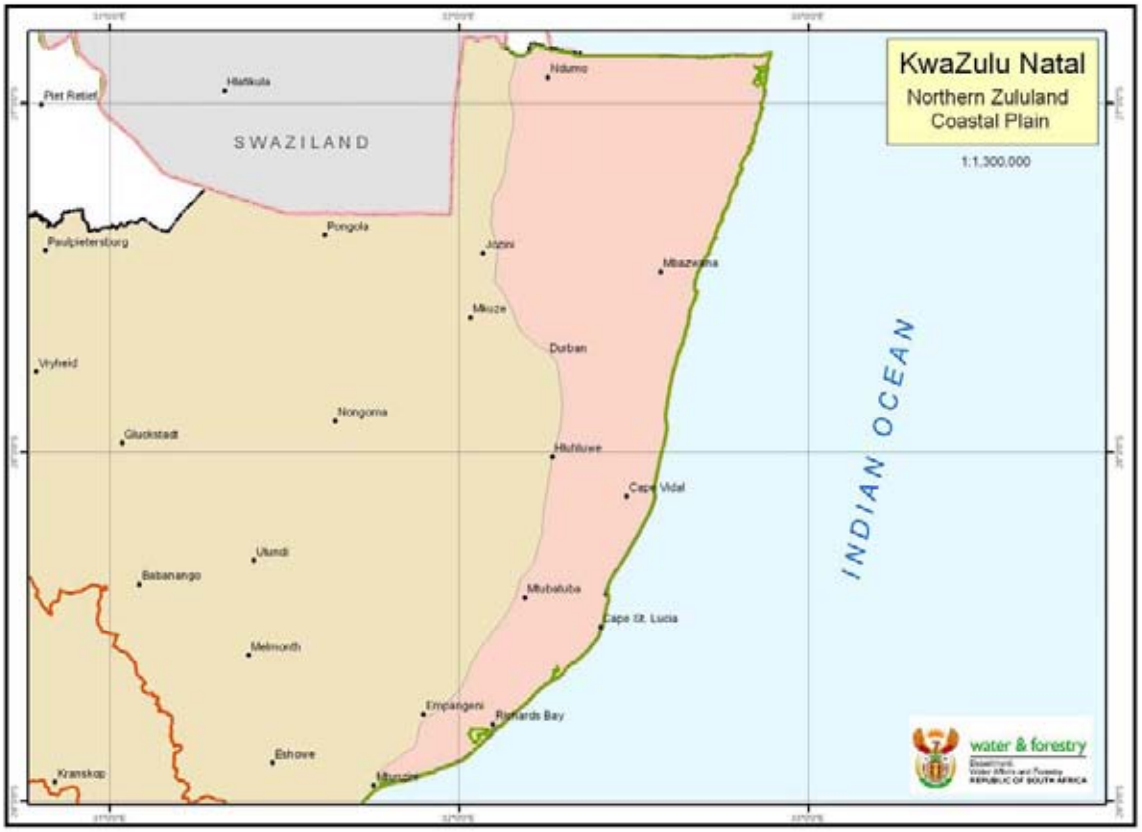
The following two 1:500 000 scale hydrogeological maps cover the KwaZulu-Natal Province, i.e. Vryheid and Durban.

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. 0-0,1*l/s,* 0,1-0,5*l/s*, 0,5-2,0*l/s*, 2,0-5,0*l/s* and >5,0*l/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 still there be any water, a wind pump or hand pump could be installed. At best this could be enough for individual household supplies.
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 or single households. Little additional groundwater could 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 - enough water for either hand- and/or wind pumps, i.e. small supplies for small communities and/or stock watering or single households can easily be achieved. 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 wellfields 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 2*l/s* for 8hours per day, 2000 persons, @25*l/day*, can be supplied comfortably.
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. Wellfields and the concomitant benefit for the management of aquifer(s) make the development of groundwater within medium high potential aquifers very attractive. Pumping at 5*l/s* for 8hours per day, 5000 persons, @25*l/day*, can be supplied comfortably.
High development potential – Large-scale irrigation and/or large village and even large town supplies can be obtained from these aquifers.

3.3 Northern Zululand Coastal Plain Hydrogeological Region

Figure 2: The distribution of the Northern Coastal Plain Hydrogeological Region



3.3.1 Economic activities

Several conservation areas, i.e. Nduma, Tembe, Kosi Bay, St. Lucia Bay, Pumulanga and Sordwana Bay occur within this hydrogeological region. Ecotourism thus forms the mainstay of economic activities of the area and poses low risk for pollution and or over-abstraction.

Mining of heavy metal deposits and the industries in and around Richard's Bay poses a high risk of pollution.
Some forestry, i.e. pine and eucalyptus, and a limited amount of sugar cane is planted is found within this region. The impact of the plantations on groundwater is unknown.

Many rural villages which are large or wholly dependent on groundwater occur in this region. However, the level of groundwater use is completely unknown.

3.3.2 Aquifer properties and protection measures

The geology consists of unconsolidated coastal deposits and thus granular type of aquifers occurs throughout the region. The development potential is shown as low to medium on the Vryheid Hydrogeological map (scale 1: 500 00). From first principles one must accept that that these types of aquifers are vulnerable to pollution. Depending on the level of dependence of the rural settlements the risk can be between low and medium.

Subsistence farming would in all probability be another economic activity in this region.

Development:
At this point in time nothing can be said about the any further development and the current level of groundwater use first need to be determined.

Utilisation: It is virtually a given that groundwater is used for irrigation in all areas where surface water is used. However, even with no known irrigation boards within this region, the use of groundwater for small-scale irrigation of sugarcane is not excluded - this premises needs to be verified. The extensive rural settlements will in all probability depend wholly or largely on groundwater and this need to be established.

Protection: From first principles it can be assumed that this type of aquifer is very vulnerable to pollution and needs protection. However, nothing is known about the sources of pollution and these needs to be determined.

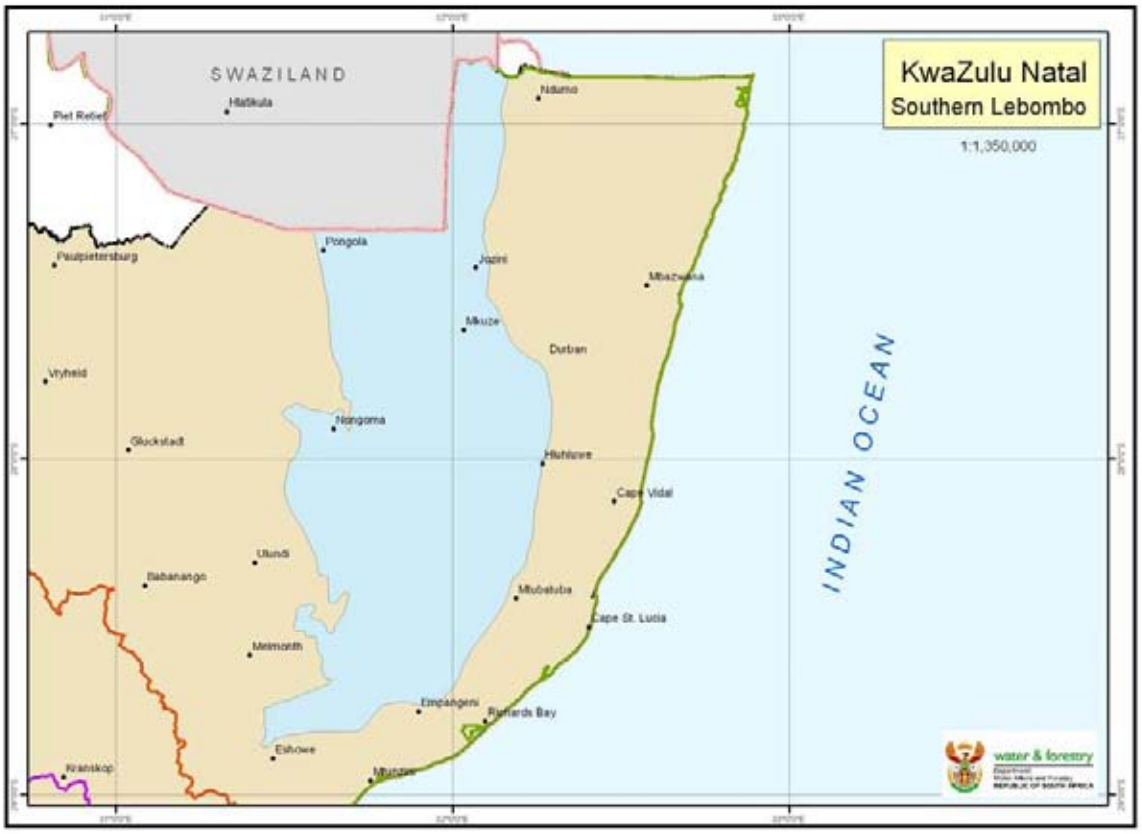
3.3.3 Summary of known problems and risks

- The mining of heavy minerals in the Richard Bay area poses impacts on groundwater. The EIA and ERMPs for this mining operation needs to be studied to determine the level of risk and only then can appropriate actions be defined;
- The level of groundwater use in all of the rural settlements needs to be determined before any groundwater management actions can be initiated;

Actions: - Survey of the level of dependence on groundwater in all the rural settlements.

3.4 Southern Lebombo Hydrogeological Region

Figure 3: The distribution of the Southern Lebombo Hydrogeological Region



3.4.1 Economic activities

A few private game reserves between Ulundi and Pongola and Hluhluwe Game Reserve (one of the national reserves of the RSA) are one of the economic activities of this region.

In and around Pongola there are some sugar cane plantations and a sugar mill. The following irrigation boards occur in this region: - Impala, Heatonville, Railway Valley, Mkuzi Falls and Nkwaleni.

Many rural settlements occur in this region.

3.4.2 Aquifer properties and protection measures

The region is underlain by argillaceous and arenaceous and mafic intrusive rocks. The aquifer type is mapped as intergranular and fractured with a low to medium development potential.

Development: Without any knowledge about the level of groundwater use by any of the economic sectors mentioned above, nothing can be said about excess groundwater available for augmentation where surface water sources are already over extended.

Utilisation: With five irrigation boards in this region it is reasonable to assume that groundwater is used for irrigation purposes. However, this assumption needs to be tested and if found to be correct the level of groundwater use must be determined.

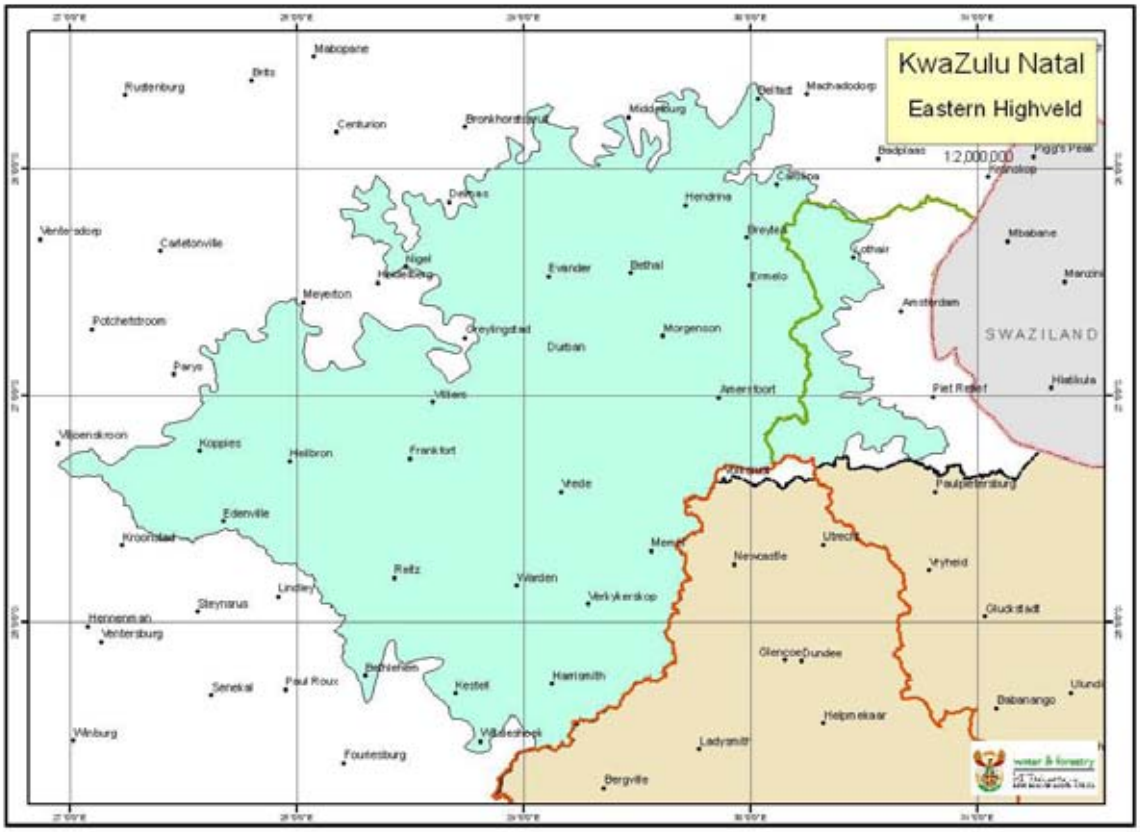
Protection: with monotonous regularity the phrase 'no protection actions can be defined unless the level of use and potential threads to groundwater has been determined' will be repeated.

3.4.3 Summary of known problems and risks

- Nothing can be said about any risks and or any action suggested except that the collection of all relevant groundwater data is of the utmost importance.

3.5 Eastern Highveld Hydrogeological Region

Figure 4: The distribution of the Eastern Highveld Hydrogeological Region



3.5.1 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 the main crop, is probably 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.

Another known large-scale economic activity in this region is plantations and the processing of wood and production of wood products. The Ithala Game Reserve also occurs in this region.

3.5.2 Aquifer properties and protection measures

The Eastern Highveld Hydrogeological Region covers only a small portion of the north-eastern parts of the KwaZulu-Natal Province. The rocks found here belong to the Ecca Formation, which forms part of the Karoo Supergroup. The rocks where formed during the Permian eratem, which was an extremely wet period in the history of then 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 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 and implemented in the Province for the province is made. Refer to appendix B about 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.

3.5.3 Summary of known problems and risks

Coal mining and its associated problems, i.e. acid mine drainage, poses some risk for surface water pollution.

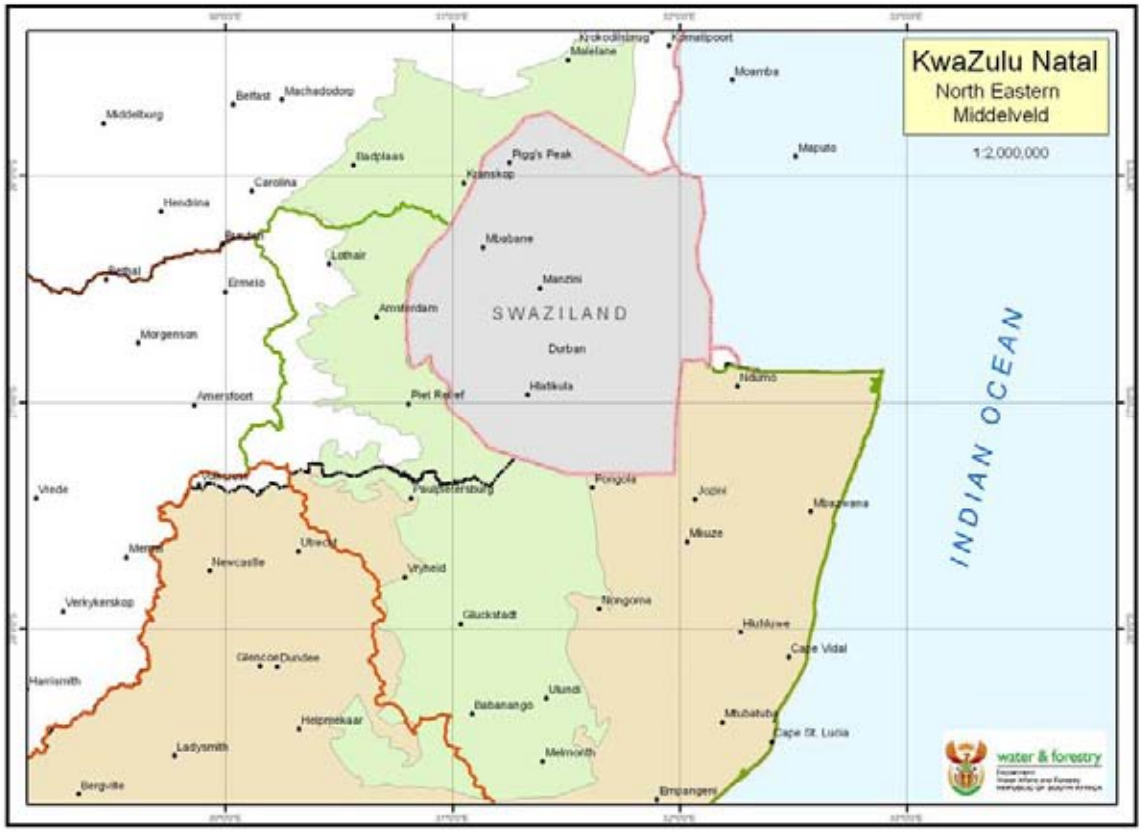
The pulp and paper industry also poses a hazard towards pollution.

Plantations do have an impact on both surface water and groundwater. A surface water-groundwater interaction project is strongly recommended in this area. This will assist future license application for the extension of plantations.

No data exists for this region and in seen as one of the most urgent priorities for this particular region.

3.6 Northeastern Middleveld Hydrogeological Region

Figure 5: The distribution of the North-eastern Middelveld Hydrogeological Region



3.6.1 Economic Activities

Coal mining, plantations and farming forms the brunt of the economic activities of this region.

Many rural settlements occur within the boundaries of this region but their level of dependence on groundwater for domestic water supplies in at best only conjecture.

3.6.2 Aquifer properties and protection measures

The aquifer types are mapped (Vryheid) as fractured with a low development potential and intergranular and fractured with a low development potential. The diamictites forms the fractured aquifers and the arenaceous and argillaceous rocks forms the intergranular and fractured aquifers.

Development

The development potential of this region is uniformly low, thus able to supply basic water to small rural settlements with at least some capacity for community gardens.

Utilisation
Nothing is known about the level of groundwater use in this region. In all probability all the rural settlements is totally or largely dependant on groundwater.

Protection
With nothing known about the use of groundwater in the region, no comments can be made regarding the projection of the groundwater resources although the hazard of acid mine drainage poses a medium to high risk.

Management
With nothing known about the use of groundwater in the region, no comments can be made regarding the management of the groundwater resources.

Data/information management
The lack of data is hampering any systematic decisions regarding the protection and/or management of groundwater to be taken and the collection of all available data is of the utmost importance.

3.6.3 Summary of known problems and risks

- Lack of data about groundwater use (domestic and agricultural), which is hampering any systematic decisions regarding protection and management to be taken. A GRIP is strongly recommended.

3.7 North-western Middleveld Hydrogeological Region

Figure 6: The distribution of the North-western Middelveld Hydrogeological Region

3.7.1 Economic Activities

The following irrigation boards occur within this region: - Ixopo, Polela, Mzalanyoni, Karkloof, Mnyamvubu, Mooi River, Little Mooi River, Sterkspruit, Little Tugela, Lindequespruit, Bergvliet, Sundays River, Dwars and Nkunzi.

Forestry forms a large part of the economic activity in this region. Pine tree, eucalyptus and wattle trees are planted.

Coal mining is probably the mainstay of economic activities in this region and is centred on the towns of Glencoe, Dundee and Newcastle.

Stock farming forms the rest of the economic activities.

Rural settlements probably largely dependant on groundwater in the forms of springs, occur in this region.

3.7.2 Aquifer properties and protection measures

The 1: 500 000 scale hydrogeological map, indicate the aquifer type as intergranular and fractured with an extremely low to medium development potential. The underlying geology is mostly arenaceous rock of the Ecca Formation.

Development: unless the current level of groundwater use has been determined, no comments can be made regarding further development and any augmentation of stressed water resources. The level of utilisation of groundwater compared against the groundwater development potential can be used to indicate the possibility of augmentation. With the results of the Groundwater Assessment project Phase 2, available some low confidence level answers could become available. However, with good quality and up-to-date data a higher level of confidence could be achieved.

Utilisation: Nothing is known about the extent of groundwater use by the 14 irrigation boards that occur in this region. It is however, save to assume that groundwater is definitely being used but the level of use need to be determined.
It is possible the coal mines occurring in this region, might use some groundwater. One can assume that some data in this regard might exist in the form of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMPR) reports. However, the total lack of access data this data is hampering any decisions.

Protection: The protection of the aquifers of the RSA, is of the utmost importance, especially where the potential of polluting a productive aquifer and the impact of that pollution is both high, i.e. the risk is high. However, the Ecca Formation, consisting mostly of shale is not known for its high water yielding capacity. The bigger danger is the pollution of surface water sources through the decanting of mines.

The impact of the plantations on groundwater has not been quantified, although indications are that it can be considerable. The impacts need to be studied in more detail and in the mean time it would be prudent to refrain from extending the current level of plantations.

Management: The management of the groundwater resources of South Africa in general is poor. However, through the licensing of mines and industries, there is an opportunity to improve this aspect. The regional groundwater staff members just need to get involved in the Directorate: Water Quality Management's operations to ensure that the correct actions are carried out. The aspect of 'correct actions' however, still needs to be defined and in the section on 'Co-operation' this will be addressed.

Data/information: management: Just the fact that the groundwater staff does not have access to EIAs and EMPRs is already an indication of the poor data management practices in the KZN Region.

3.7.3 Summary of known problems and risks

- Acid mine drainage and its impacts on both the surface and groundwater sources is a problem.
- Impacts of plantations are a great unknown.
- Nothing is known about the level of dependence of rural settlements on groundwater as a source of domestic water.
- Lack of good quality and up-to-date data.

Actions: -
Improve data management immediately by appointing more staff, obtain all relevant EIA reports, code the data and capture onto the Open-NGDB

3.8 Kwazulu-Natal Coastal Foreland Hydrogeological Region

Figure 7: The distribution of the KwaZulu-Natal Coastal Foreland Hydrogeological Region

3.8.1 Economic Activities

An extensive sugar cane industry occurs in this region. The processing of sugar cane forms the mainstay of industries in this region.

Several metropolitan areas (inter alia Durban, Stanger and Pietemartizburg) which is heavily industrialised occur in this region. Some of the industries utilises groundwater heavily.

Mining activities include sand-winning, marble mining and aggregate quarrying.

Many rural settlements also occur in this region.

3.8.2 Aquifer properties and protection measures

The fractured aquifers are formed by predominantly arenaceous rocks consisting of sandstone and diamictite that is Dwyka tillite. Contrary to the general knowledge King (1997) found that the Dwyka tillite forms very productive aquifers in the KZN Province.

The intergranular and fractured aquifers are formed meta-arenaceous and acid/intermediate intrusive rocks.

Utilisation: The highest known groundwater usage (industrial use within the Durban metropolitan area) occurs in this region. Several irrigation boards also occurs within the borders of this region although nothing is known about their level of groundwater use.

Protection: Industries within the Durban metropolitan area uses groundwater but it is heavily polluted. The long-term use of groundwater by these industries is under thread due to the pollution.

Management: Although 12 monitoring boreholes occur within the boundaries of the Durban Metropolitan area, the data quality is poor and discontinues. It is important that this is rectified. The Durban Municipality apparently does not do any monitoring and have little or no data either.
Data/information management: Level of data management is extremely poor.

3.8.3 Summary of known problems and risks

- Pollution of the Durban Aquifer;
- The management of the Durban Aquifer needs to be improved through the establishment of more monitoring boreholes and better data management.

Actions: -

- The level of dependence on groundwater in the rural village needs to be established.
- The pollution hazard by industries needs to be defined.
- Data management must be improved.

3.9 Transkeian Coastal Foreland and Middleveld Hydrogeological Region

Figure 8: The distribution of the Transkeian Coastal Foreland Middelveld Hydrogeological Region

3.9.1 Economic Activities

Quite a lot of agricultural activities is taking place in region. The following irrigation boards occur within the boundaries of this region: Nkonzo River, Polela, Underberg, Ngwangwane and Umsinbutu.

Wattle plantations are also important and many rural settlements occur within this region.

Many rural settlements occur within the boundaries of this region.

3.9.2 Aquifer properties and protection measures

The aquifer types occurring in this region are mapped as low to medium potential and the geology consists of mostly arenaceous rocks.

Development: Nothing is known about any further development potential of the region and thus no comments can be made regarding possible augmentation.

Utilisation: As said before the irrigation boards will be using groundwater to some extent. A hydrocensus in and around Kokstad will help to determine the level of groundwater use within the agricultural sector.

Nothing in known about the sources of water for the rural settlements in this region i.e. surface- and/or ground water.

Protection: Once the above mentioned hydrocensus has been more comprehensive data sets will be available and the level of protection needed could be determined.
Management: No known management of groundwater is taking place. Once the hydrocensus has been completed and the volume of groundwater being used is available, it would be possible to prioritise some management actions, which could include inter alia the incorporation of groundwater monitoring within the relevant irrigation boards.

Data/information management: The words 'unknown' and 'nothing known' are a strong indication of lack relevant data. The hydrocensus being conducted will assist in gaining a better understanding of groundwater in this region. Geohydrology staff members must use this opportunity to ensure that appropriate data management practices are established.

3.9.3 Summary of known problems and risks

- Nothing can be said.

4. REPORTING OF DATA AND INFORMATION

4.1 Introduction

As stated previously 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;

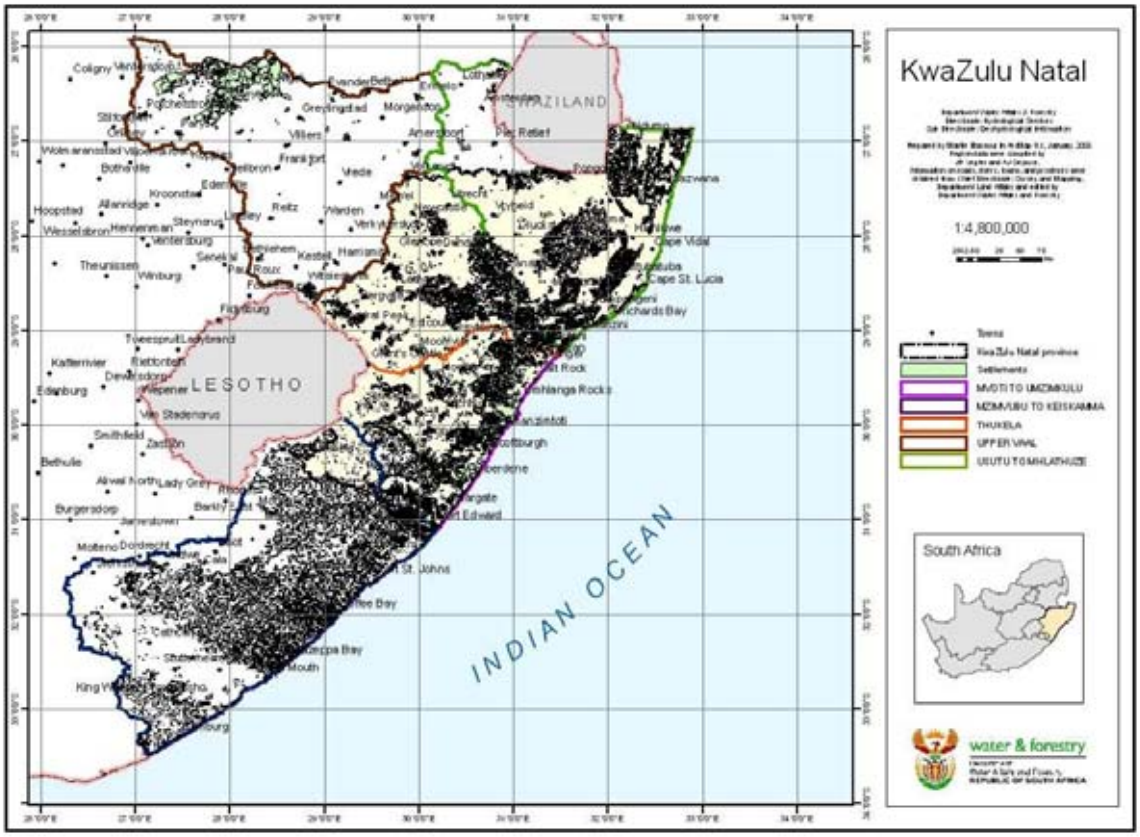
This aspect in itself constitute a project; It is however, suggested that it be conducted in-house.

5. SUMMARY

5.1 Rural water use

There are approximately 11 800 rural settlements within the area of jurisdiction of the KwaZulu-Natal Regional office - refer to Figure 9 for the spatial distribution of the rural settlements. In all probability most of these settlements would be largely of wholly dependant on groundwater for their domestic supplies and thus represents a large component of the domestic water use sphere. However, very little, or no data are available on a) their dependence on groundwater, b) their vulnerability to droughts and c) the volumes being abstracted, all of which is needed to define the level of the impact on the groundwater resources of the underlying areas. Furthermore, no proactive action can be taken in terms of mitigating either vulnerability or augmentation of the supply where there are shortages.

Figure 9: Spatial distribution of rural settlements in KwaZulu-Natal



With the above mentioned shortcomings in mind a Groundwater Resources Information Project (GRIP) is strongly recommended. The project can be broken up into three phases which will run over a three to four year period. The broad scope of each phase would be the following: -

- Phase 1 would be the collection of all the available groundwater data in reports, files and whatever other media and the capturing of all this onto the National Groundwater Database.
- Phase 2 would entail the verification of the geosites positions and the collection of data on newly established geosites, inter alia water levels, status of pumping equipment and water sample for chemical analysis and water use data.

- Phase 3 would entail the testing of boreholes to determine the transmissivity and the storativity of the relevant geohydrological strata (if and where unavailable), production of relevant information products to support the district municipalities and the setting up of a well defined regional monitoring network.

The full involvement of all the DMs is an integral and indispensable part of the whole GRIP in KZN. For a comprehensive description of the project see the KZN-GRIP Business Plan and the scope of Phase 1, see the ToR: Phase 1 – KZN-GRIP.

5.2 Agricultural water use

Many irrigation boards/WUAs occur within KZN's area of jurisdiction. Very little 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. 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 were groundwater management is needed the most urgently and implement it within these organisations.

5.3 Other groundwater-related issues

5.3.1 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 would be sustainable.

5.3.2 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 KZN is strongly recommended.

5.4 Summary of actions

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

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; 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. Apply methodology to other settlements/area where groundwater is use wholly or largely for domestic water supplies. Draft ToR for project in progress.	1
Survey of agricultural groundwater use	Envisaged steps are: - 1. Identify all areas where irrigation is taking place; 2. Choose well demarcated area and determine volumes for both surface and groundwater use; 3. Test SAPWAT's capability to calculate same figures; 4. Calculate the value of the contribution ground-water is making. Apply methodology to other areas under irrigation. Draft ToR for such a project has been drawn up.	1
Extend the monitoring based on the outcomes of the above two projects	1. Domestic water sector: - Start monitoring in areas where multi-sectoral users use a common source as this poses the highest potential conflict. 2. Agricultural sector: - Start monitoring to in both potential impacted areas and pristine areas. Current staff could be used to execute geophysical surveys to identify the specific monitoring borehole sites once a general area has been chosen.	2
Implement Data Acquisition Strategy	The following steps are needed to implement this Strategy: - 1. Identify all potential suppliers of groundwater data; 2. Adapt the Strategy to reflect conditions in the Region. 3. Implement Strategy.	
Aquifer Protection	The following steps are needed to implement this actions: - 1. Identify all mine in the Region (use SGD to collect data).	

	2. Determine the level of monitoring these mines are already doing. 3. Determine the amount of data available and identify the steps necessary to capture the data. 4. Start with the capturing of the borehole data onto the NGA first. 5. Identify and train staff who can do the capturing of water quality data onto the WMS.	

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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 ralation 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

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 (1996) 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 safe-guard, 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 KwaZulu-Natal 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 is 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.

Table1: 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;

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

4. 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 KWAZULU-NATAL

No.	Secretary	Chairperson
8	**Bergville IB**	
	Mrs. S. Findlay P. O. Box 133 Bergville 3350 Tel: 036 448 1713 (w) Tel: 036 448 1748 (h) Fax: 036 488 1713	Mr. I. A. Doidge P. O. Box 182 Bergville 3350 Tel: 036 448 1713 Fax: 036 488 1713
6	**DWARS Nkunzi IB**	
	Messrs. Reay & Vernon Lee P. O. Box 491 Ladysmith 3370 Tel: 036 637 2161 Fax: 036 631 1510	Mr. S. de Villiers Private Bag X112 Wasbank 2920 Tel: 034 651 1667
4	**Gluckstadt IB**	
	Mrs. E. Steenkamp P. O. Box 48 Black-Mfolozi 3115 Tel: 034 952 1617 Fax: 034 942 1777	Mr. J. L. Erasmus P. O. Box 642 Vryheid 3100 Tel: 034 952 1611
9	**Heatonville IB**	
	Mr. M. M. Easton P. O. Box 67 Heatonville 3881 Tel: 035 792 8434 Fax: 035 792 8436 E-mail: Malcolm.easton@hullets.co.za	Mr. W. D. Nelson P. O. Box 21 Heatonville 3881 Tel: 0351 92 8420 Fax: 0351 92 8420
24	**Hlatikhulu Little Mooi**	
	Mrs. D. Lees P. O. Box 134 Moooi River 3300 Tel: 033 263 1404 Fax: 033 263 1569	Mr. Gawith P. O. Box 94 Rosetta 3300 Tel: 033 263 7344/5 Fax: 033 263 7121 E-mail: rosettafarm@futurenet.co.za
41	**Illovo IB**	
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1	**Impala IB**	

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46	**Ixopo IB**	
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26	**Karkloof IB**	
		Mr. R. Stubbs P. O. Box 658 Howick 3290 Tel: 033 330 2822 (w) Fax: 033 330 4602
12	**Lindiquespruit IB**	
	Mr. S. W. van Zuydam P. O. Box 22 Winterton 3340 Tel: 036 488 1524/5 Fax: 036 488 1116	Mr. R. Lund P. O. Box 15 Winterton 3340 Tel: 036 488 1252
15	**Little Tugela IB**	
	Mr. S. W. van Zuydam P. O. Box 22 Winterton 3340 Tel: 036 488 1524/5 Fax: 036 488 1116	Mr. J. Muirhead P. O. Box 180 Winterton 3340 Tel: 036 488 1624
29	**Lower Umvoti IB**	
	Mrs. G. Bressler P. O. Box 725 Stanger 4450 Tel: 032 437 2126 Fax: 032 551 1622/3264	Mr. I. Kerr P. O. Box 725 Stanger 4450 Tel: 032 437 2205 Fax: 032 551 1622/5384 E-mail: iaink@sappi.co.za
3	**Mkuzi Falls IB**	
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25	**Mpolweni/ Sterkspruit IB**	
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19	**Muden IB**	
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44	**Mzalanyoni IB**	
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10	**Nkwaleni IB**	
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37	**Polela IB**	
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17	**Sterkspruit IB**	
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5	**Sundays River IB**	
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52	**Umfuli IB**	
	Mrs. C. D. Foss P. O. Box 21 Nkwaleni 3816 Tel: 035 792 8210 Fax: 035 792 8227	Mr. C. Chance P. O. Box 15 Nkwaleni 3816 Tel: 035 460 0734 Fax: 035 460 0725
39	**Umlaas IB**	
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49	**Umzimkulwana IB**	
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48	**Umzimvubu IB**	
38	**Underberg IB**	
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13	**Winterton IB**	
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31	Middle Umgeni	
34	Merrivale	
47	Mzintlava	
51	Injambili	
22	Nyoni	