

each waste water treatment works. Population, service level and land-use information were the main factors used in the models to estimate the future water use. In total, 53 areas were configured.

The population scenarios were developed by Prof Jeff McCarthy of the University of KwaZulu-Natal and additional information from the housing implementation programmes of the eThekweni and Msunduzi municipal areas was used to refine the estimates.

The water requirement scenarios for the North Coast areas were based on various planning studies carried out by Umgeni Water, the DWEA and the iLembe District Municipality.

Various scenarios of future requirements were developed and the 'high' scenario was used in the planning to ensure that measures are in place to deal with that. The other scenarios were used mainly to check the impact on timing of the measures, as well as to ensure that the recommendations remain stable.

#### **WATER CONSERVATION AND WATER DEMAND MANAGEMENT SCENARIOS**

A key element of the Reconciliation Strategy was the assessment of the potential savings that could be achieved through the implementation of various Water Conservation and Water Demand Management (WC/WDM) measures. The eThekweni Municipality has a WC/WDM programme in place covering a wide range of measures for reducing losses and improving the efficiency of water use. Following detailed consultation with eThekweni it was estimated that there is scope for further WC/WDM initiatives in eThekweni and that further savings of between 9 and 23% are achievable. In the case of the Msunduzi Municipality it was estimated that savings of between 15 and 31% are achievable through further WC/WDM activities.

The harvesting of rain water, through the use of roof tanks, was identified as a measure that should be promoted and encouraged throughout the area. This will limit users' dependence on the formal water supply and also stimulate a culture of efficient water use.

Scenarios of future savings were developed, along with a programme of

measures that could be implemented. This information was integrated into the various water requirement and return flow scenarios.

#### **WATER RESOURCES**

The water resources supplying the KZN Metropolitan Area can be divided into the Mooi-Mgeni and the North Coast systems.

The Mooi-Mgeni River System includes the Mooi-Mgeni Transfer Scheme which pumps water from the Mearns Weir on the Mooi River into a stream flowing into the Midmar Dam. The Albert Falls and Inanda Dams in the Mgeni River provide additional storage. The bulk water distribution and treatment facilities are managed by Umgeni Water. The conveyance pipe network is illustrated in Figure 1.

The North Coast System consists of the Mdloti River, regulated by the Hazelmere Dam in the south, and the largely unregulated Mvoti River from where river-runoff abstraction takes place, and extends to the Thukela River in the north.

#### **BULK AUGMENTATION OPTIONS**

Various possible future surface water resources with their associated conveyance systems were identified and considered as schemes to meet the growing water requirements. They were:

- Spring Grove Dam in the Mooi River
- Smithfield Dam in the Mkomazi River
- Raising of the Hazelmere Dam to augment the supply in the North Coast Area
- Abstraction of water from the Lower Thukela River to supply the Far North Coast Area
- A dam on the Mvoti River

#### **REUSE OF WATER FROM WASTE WATER TREATMENT WORKS**

Significant volumes of treated waste water are processed by eThekweni and preliminary evaluations of the volumes from the different treatment works indicated that approximately 60 million m<sup>3</sup>/annum would be suitable for further treatment to meet urban water-use requirements.

The time taken to implement a reuse scheme is significantly shorter than that for a large dam development, which makes it an attractive option. eThekweni has initiated a dedicated

feasibility study to investigate this option in more detail. Umgeni Water is also investigating the feasibility of reusing water from the Darvill treatment works.

### DESALINATION OF SEA WATER

A study to investigate the feasibility of desalination of sea water as an option to provide additional domestic water is being undertaken by Umgeni Water. Preliminary indications suggest that desalination of sea water is still more expensive than other options, although it is recognised that at some point in the not-too-distant future this form of water treatment will become economical.

### YIELD ASSESSMENTS

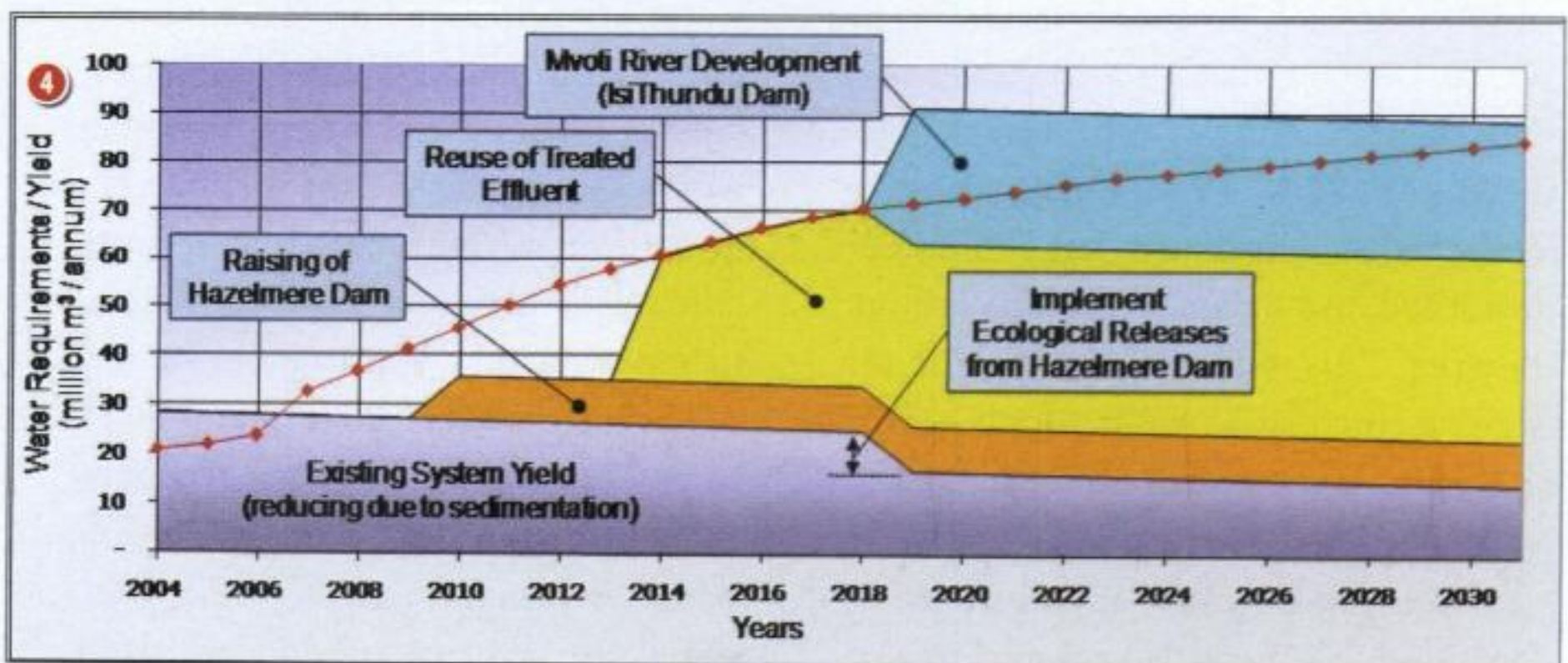
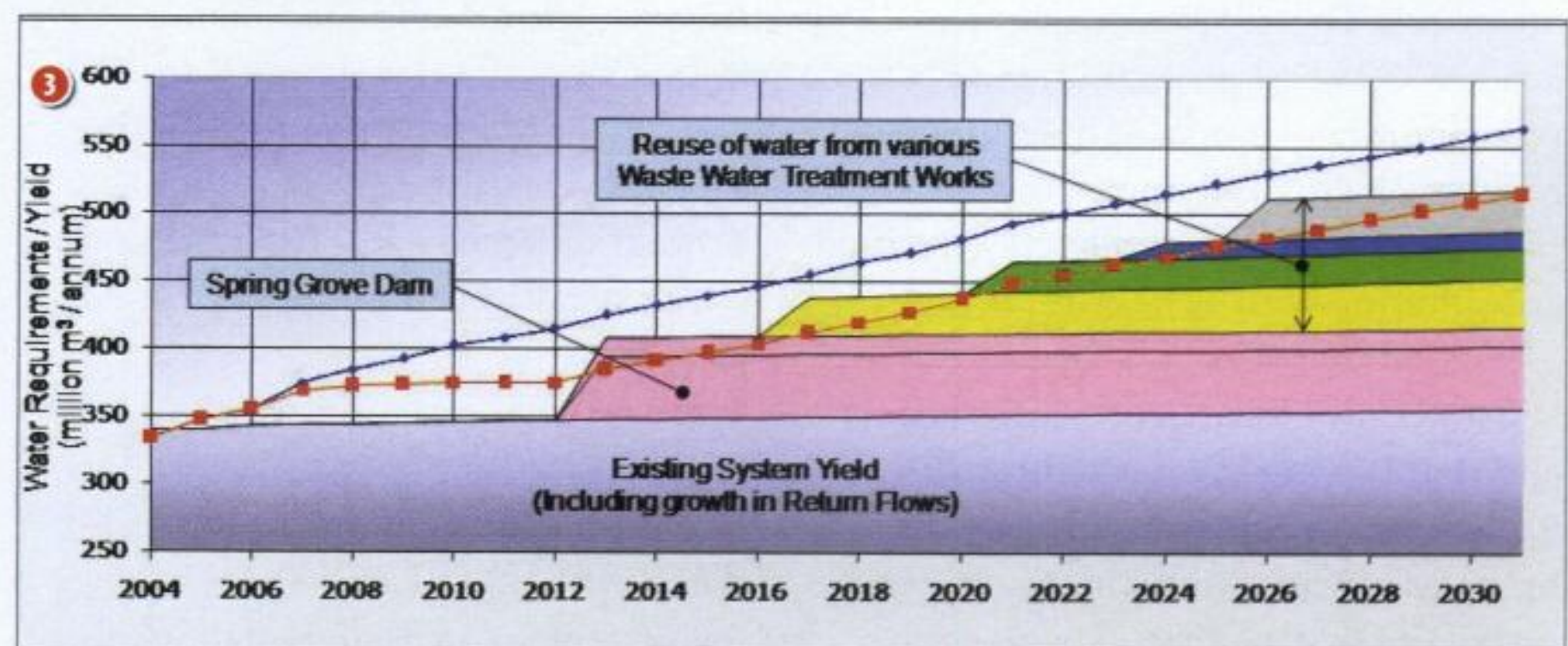
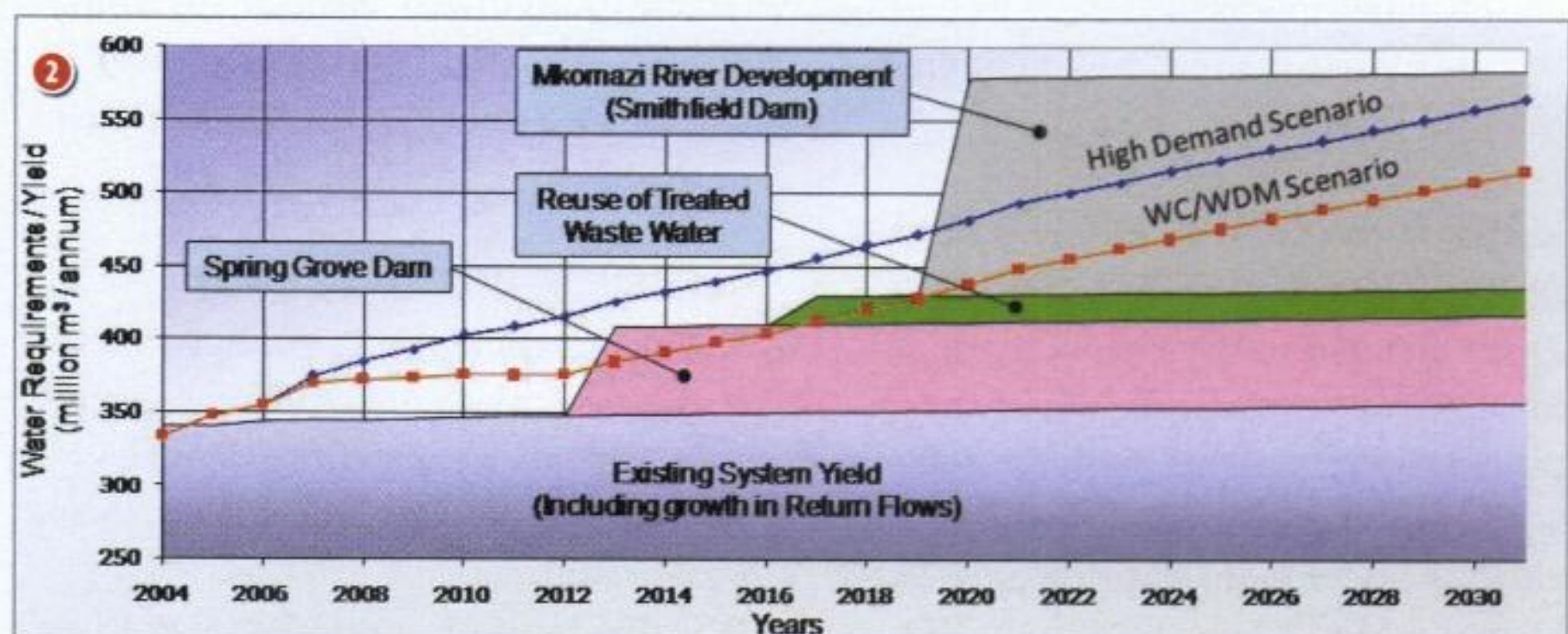
Information on the availability of water from the existing water resources and potential bulk schemes was obtained from previous hydrological and system

analysis studies. Only in cases where assumptions have changed were the yield analyses revised using the Water Resources Yield Model.

### WATER BALANCE AND RECONCILIATION

The water balance situation for the Mooi-Mgeni River System is presented in Figure 2. The upper water-requirement projection represents the 'high' scenario which excludes further WC/WDMs and the lower projection indicates the 'high' water-demand scenario based on the case where water-loss management initiatives have been implemented. If one compares the water requirements with the existing long-term system yield it can be seen that there is currently a significant shortfall.

The only suitable option for reducing the shortfall in the short term is to implement WC/WDMs. However, even with the WC/WDM savings, the system will remain in a negative balance situation until the Spring Grove Dam can deliver



- ② Mgeni River System Water Balance and Reconciliation Scenario
- ③ Mgeni River System Water Balance and Reconciliation Scenario with full reuse potential
- ④ Mdloti-Mvoti System Water Balance and Reconciliation Scenario (Reuse of Treated Effluent)

water by 2012. Further augmentation will be required in 2017, which is two years before the earliest possible commissioning date for the Smithfield Dam (Mkomazi-Mgeni Transfer Scheme). The shortfall from 2017 to 2020 can be met by reusing treated waste water as indicated.

However, it would also be possible to exploit the reuse option to the full. This would delay the need for the Mkomazi River development to beyond the current planning horizon of 2030. This is shown in Figure 3.

Figure 4 presents the projected water balance for the combined Mdloti (Hazelmer Dam) and Mvoti River Systems and indicates that shortfalls will be experienced even with the raising of the Hazelmer Dam until a reuse option can be implemented in 2014. The earliest date by which the Mvoti development (a large dam) could deliver water is 2018, as indicated.

The reduction in yield in 2019 indicated in Figure 4 represents the implementation of the Ecological Water Requirements (EWR), involving river releases from the Hazelmer Dam. This will be possible only when the development on the Mvoti River has been commissioned, in order to limit the risk of supply failures over the short term.

An alternative augmentation scheme to the reuse option involves utilising the surplus yield in the Lower Thukela River, which could deliver water by 2014. This Lower Thukela option does not require a regulating storage structure and hence a significantly shorter implementation period is needed compared with the Mvoti River development option. However, it will limit the availability of additional water supply to other areas in the Thukela River.

### MANAGING THE INITIAL SHORTAGES

Both Figures 2 and 3 show shortages from now until other measures can be implemented. The line on each graph showing the water available from the current schemes is based on the so-called 1:100 year yield, which is an appropriate assurance level used in the planning for metropolitan areas. This effectively means that shortages will be experienced by the users only if a very severe drought occurs during this period. It is thus entirely possible that this period may pass without any problems. However, if a serious drought occurs, it will mean that water restrictions will

have to be implemented rigorously to ensure that basic human needs and the requirement for the industries that drive the economy of this area are met.

### PERSPECTIVE ON WATER QUALITY MANAGEMENT

The following water quality management issues will have to be considered when evaluating the indirect and direct reuse options proposed in the Reconciliation Strategy:

- The waste water treatment plants (WWTPs) identified for reuse must be functioning correctly and producing water of a quality that is consistent with the installed technology. The industrial component of the effluent should also be limited to 10%.
- The water from the WWTPs that is prepared for indirect reuse will require an additional process to remove nutrients and microbiological pollution. This will protect the water stored in the receiving dams from becoming eutrophic.
- The water from the WWTPs may contain harmful levels of endocrine disruptors, pathogens and toxic substances. A number of barriers must be added to the process to produce water suitable for reuse as potable water.
- The public's perception of reused water and possible resistance to consuming it will have to be managed very carefully.

The issues listed above will be addressed in more detail in the reuse feasibility study begun by eThekweni.

### STAKEHOLDER INVOLVEMENT

From the outset of the study, partnerships were formed with key stakeholders representing the various sectors of society and, in particular, close cooperation was achieved between eThekweni Metropolitan Municipality, Umgeni Water and the DWEA.

Stakeholder involvement was facilitated by various public meetings at which representatives were selected to serve on the Study Steering Committee. The management of technical matters was undertaken by a Study Technical Committee.

### RECONCILIATION STRATEGY

From the findings of the water reconciliation scenarios, specific strategies were identified that are required for the sustainable management of the water resources in the study area. These strategies are outlined below.

*A study to investigate the feasibility of desalination of sea water as an option to provide additional domestic water is being undertaken by Umgeni Water. Preliminary indications suggest that desalination of sea water is still more expensive than other options, although it is recognised that at some point in the not-too-distant future this form of water treatment will become economical*

## Priority infrastructure projects

- Implement the Mooi-Mgeni Transfer Scheme consisting of the Spring Grove Dam in the Mooi River catchment and a conveyance system to deliver water by 2012. The Department has recently directed the Trans-Caledon Tunnel Authority (TCTA) to implement the scheme.
- Raise the Hazelmere Dam to provide additional yield and extend the water-treatment capacity and related infrastructure.
- Proceed with the planning and implementation of the proposed bi-directional North Coast Augmentation Pipeline to convey water from the Hazelmere Dam to KwaDukuza and adjacent areas.

## Priority feasibility and supporting studies

- Proceed with the feasibility study of the Mkomazi River Transfer Scheme; the first phase will consist of the proposed Smithfield Dam with gravity conveyance infrastructure for transferring water into Umgeni Water's bulk supply system.
- Commission a feasibility study of the Thukela and Mvoti Systems to support the far northern areas (KwaDukuza and surrounding developments) and to augment the water resources of users currently supplied from the Hazelmere Dam.
- Undertake a feasibility study to investigate the options for reusing treated waste water, for direct and indirect use. Due to the urgency of the supply situation, eThekweni appointed consultants for this task in February 2009.

## Water-use efficiency

- Intensify the WC/WDM programmes in the eThekweni Municipality; the study confirmed the potential for further water savings and recommends the continuation and extension of measures to reduce losses and improve water-use efficiency.
- Plan and implement WC/WDMs in the Msunduzi Municipality supply area. The potential for savings in water use is high.
- Encourage and support rain water harvesting in the study area as it is a further method of extending the water resources.

## Other initiatives

- Construct a flow gauge on the Mvoti River in order to improve confidence

in the hydrological modelling and yield estimates of the system.

## Institutional arrangements

- Constitute the System Operation Management Forum and promote active involvement in the operational management of the Mgeni and Mdloti River Systems among the relevant institutions. Consideration should be given to the early implementation of drought restrictions to ensure that water is available for essential use.
- Convert the Study Steering Committee into a Strategy Steering Committee, which will be responsible for the review, maintenance and updating of the strategy.

## CONCLUSIONS

Clear strategies have been recommended to ensure enough water for this very important area. Successful implementation of these measures will now have to receive the highest priority.

Coordination among all the institutions involved in the water supply cycle was essential to share relevant information and apply valuable knowledge to formulate and endorse the Reconciliation Strategy.

The integration of information from relevant past studies and other development planning initiatives prevented duplication of efforts and ensured that the strategy is in line with other processes.

Stakeholders have embraced the urgent need to improve the water supply situation in the KZN Metropolitan Area and extraordinary, 'business unusual', steps are being taken to implement the components of the strategy.

## Study status

The study is scheduled for completion by the end of 2009 and all the reports will be available on the Department's website at <http://www.dwaf.gov.za/> □

## PROJECT TEAM

The study was undertaken on behalf of the client, Directorate: National Water Resource Planning of the Department of Water and Environmental Affairs (formerly the DWAF) by DMM Development Consultants, Golder Associates Africa, Kwezi V3 Engineers, WRP Consulting Engineers and Zitholele Consulting, supported by various subconsultants, collaborating institutions and DWEA directorates.