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LIES HIDDEN IN THE ROCKS

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24 MONTHS TO FIFA 2010

ON THE COVER
One of GEL’s new Beretta T46 drilling rigs installing lateral support to the Western access tunnel at the Soccer City Stadium where the 2010 FIFA World Cup final will be played. This tunnel was constructed under the existing West grandstand, with supported faces of up to 9 m high, in total, approximately 500 m² lateral support was installed to three tunnels and the multi-storey parkade.

Ensuring solid foundations for the FIFA World Cup’s flagship stadium

Civil Engineering | June 2008
One solution to water supply problems lies hidden in the rocks

THE SECURITY AND QUALITY of the water supply is a major issue facing every South African community. From tiny dorps to big cities, the demands for potable and industrial or agricultural usage water are ever increasing.

Some areas are fortunate to have either or both consistent rainfall and sufficient river and dam capacity, but many municipalities are subject to seasonally distorted rainfall patterns and some face radical demand spikes (for example Plettenberg Bay, which has a huge jump in usage in the peak of summer).

In the past, the solution provided by consulting engineers in bigger communities has been to build dams and in smaller towns to extract groundwater via boreholes. Both these approaches have now become problematic. Most potential major dam sites have been utilised and there is growing awareness of the massive environmental damage and subsequent hidden cost in dam construction. And the overuse of boreholes has caused an alarming drop in the water table in many areas and a subsequent decline in water quality.

Increasingly, the answer for engineers engaged in water projects is to explore the possibility of managed artificial recharging of aquifers. Artificial recharge (AR), as the technique is widely known, involves transferring river or dam water underground by means of infiltration basins or borehole injection to boost the water table and ‘bank’ the water for later usage. Buried in the rocks there is no evaporation loss – which can amount to a drop in water levels up to 3 m per annum in dams – and the dangers of contamination are markedly reduced. Unless a scheme is poorly designed, virtually all recharged water can be recovered and techniques can be used to reverse hydraulic gradients causing even ‘lost’ water to flow back into the well field.

The water usually needs to be treated before it is sent below to prevent clogging of the surface of the basins or the boreholes, although in many European countries the process itself is used for water treatment purposes with the sandy aquifers serving as giant natural filters.

Artificial recharge is a widely used concept in other parts of the world.

The Indian government recently produced a master plan for artificial recharge and is committing R33 billion to the concept over ten years in an effort to capture over 36 000 million cubic metres of water across 450 000 km².

Amsterdam receives 60% of its drinking water from a scheme that involves spreading treated river water over 40 recharge ponds covering 86 ha which have an infiltration rate of 20 cm/day and an average sub-surface travel time of 90 days. The water is then recaptured through drains and open canals situated about 60 m from the infiltration basins.

Mt Gambier in South Australia is an isolated city in an arid region and channels all of its stormwater into an
underlying karst aquifer using more than 300 drainage wells producing an annual recharge of up to 6.2 million cubic metres.

Unsurprisingly, the Israelis have pioneered artificial recharge – the biggest of their schemes in the Dan Region uses the aquifer media to supply irrigation needs from Tel Aviv’s treated reclaimed wastewater – but it’s the United States that has the most extensive history in the technique and there has been a noticeable increase in usage in the past twenty years. The largest existing operation is in the Las Vegas Valley which has a recovery capacity of 0.59 million cubic metres per day, but the Florida Everglades, New York City and San Antonio all run AR schemes.

An American Water Works Association survey shows that most schemes are used primarily for municipal supplies and for seasonal storage, but secondary benefits are also often cited like recovery of groundwater levels, prevention of saltwater intrusion, protection of habitats and improvements in groundwater quality. Although most schemes use surface water as their sole source of injection, a number involve transferring water from one aquifer to another.

South Africa’s Department of Water Affairs and Forestry (DWAF) has recently finalised a strategy on artificial recharge to encourage its expanded usage locally and also to provide a regulatory framework for implementation. The strategy is being implemented by DWAF’s Directorate: Water Resource Planning Systems.

Dr Ricky Murray, a hydrogeologist engaged by DWAF to implement their strategy, points out that ‘many of our local geological formations contain appropriate aquifers that could be used to enhance the water supply at far cheaper and more efficient rates than dams’. The capital cost of a typical AR scheme is often well under half that incurred in more conventional surface storage schemes and artificial recharge offers considerable benefits in terms of any quantifiable costs of climate change. The local authorities in Plettenberg Bay are planning borehole injection tests into the local aquifer and if the results are positive, they will be able to save on the cost of constructing an off-channel storage dam from the Keurbooms River.

The relatively limited number of South African AR schemes are all detailed in the DWAF strategy, which can be
extensive testing that included six-month-

long borehole injection tests and even longer abstraction tests established the viability of rapid replenishment and large- scale abstraction.

Dr Murray says there are several ‘success factors’ which determine the likely value of any AR scheme:

- Water used must be of a consistently high quality with low turbidity, and borehole injection methods demand higher quality than infiltration basins
- The surface water (which is usually saturated with oxygen) must be chemically compatible with the groundwater which may be more anoxic and even anaerobic
- The aquifer geochemistry is important, as some rock types might cause health problems in underground water
- The hydraulic conductivity of the rock or soil is critical. It needs to be sufficient both at the point of recharge and further afield – in hard rock environments the fractures need to be reasonably extensive and interconnected
- The hydraulic gradient will determine where the water flows once it has entered the sub-surface. In some cases it will be possible and cost effective to recover water at the point of recharge but in others it will be preferable to abstract the water down-gradient

Murray also points out that artificial recharge systems can range from the very simple to the highly sophisticated, but they all present management challenges.

In particular the issue of clogging or plugging has to be watched carefully. This can apply to the reduction of the perme-

ability of the filtration surface of the recharge facility (the basin or the borehole) or it can apply to the aquifer itself. The former is reasonably easy to monitor and remedy, the latter is more gradual and can become irreversible, especially in a borehole-fed system. Various forms of clogging have been identified including suspended solids, microbial growth, chemical precipitation, clay swelling and dispersion, air entrainment, gas binding and the mechanical jamming and mobilisation of aquifer sediments.

Furthermore, some potentially negative environmental impacts of AR schemes need to be monitored closely. A raised water table becomes more vulnerable to pollution and might exacerbate flooding; it can also cause vegetation dieback and could destabilise roads and buildings. On the other hand, lower groundwater levels can impact on river flow regimes and wetland eco-systems as well as damaging tree root systems and can cause land subsidence and the drying up of existing boreholes.

Murray is convinced that where aquifers are well understood and well monitored, the potential for AR is substantial in South Africa, especially given the high evaporation rates for surface-stored water caused by the hot and windy conditions that prevail across most of the country.

Some really ambitious thinking includes the possibility of transforming dry Northern Cape areas into fertile agricultural land through AR, as has happened in Israel and the Burdekin River Scheme in Australia. The extensive Table Mountain Group Aquifer also represents a potentially gigantic underground reservoir to meet the long-term needs of the entire region. Interfering so radically and on such a huge scale in environmentally sensitive areas is obviously at best a very distant prospect and requires considerable research, but more immediate priorities can be met almost immediately with artificial recharge at a great cost saving to ratepayers.
AS WE ALL KNOW, ‘planning’, or rather ‘lack of planning’, has become a buzz word in casual South African conversation in the past few months. Add to this the rather vague and inflammatory phrase ‘water crisis’ that has been recently introduced to the debate and it becomes evident that it is necessary to explain, briefly and in lay terms, the systems and procedures that are used for municipal water and sewer infrastructure planning.

**THE FUNDAMENTALS OF INFRASTRUCTURE PLANNING**

In the municipal context, water and sewer infrastructures consist of pipes, pump stations, reservoirs, water care works and wastewater treatment plants. Planning in this sector involves checking the sizes and capacities of the existing infrastructure, followed by the preparation of a master plan which defines the placement and sizing of improvements and additions to the existing system to meet the requirements of the future system after the expected developments have taken place. The master plan also includes the timing of these improvements as well as a capital expenditure programme for budget purposes and prioritisation of capital projects.

The basic steps are as follows:

- Develop computer models representing the existing water and sewer system so that the existing situation can be checked. Problems which already exist can be identified and addressed. The water sales for every consumer in the municipal billing database are used to populate the existing system models with accurate flow information. Sewer flow is calculated as a percentage of the water consumption.
- Determine future flows due to expected future developments within the study area. The town planners draw up a spatial development framework for the study area which identifies which land is to be developed and how it is to be developed. The information is used to determine the future water demands and sewer flows which should be catered for by the infrastructure.
- The ultimate future infrastructure model is produced using the existing system model as a base. New pipes required for the future developments are added to the existing model which is then populated with expected flows assuming that all development has taken place, all vacant stands are occupied and all sub-division of existing stands has taken place. Where the existing infrastructure is not sufficient for the future needs, improvements called master plan items are made.
- The master plan items include new reservoirs and water towers, new pipes, pump stations and valves.
- Once the master plan items have been determined, their expected costs are calculated and a master plan table is generated which summarises the required improvements, their phasing and costs.
- Once it is established that it is time to implement a master plan item, it is addressed by the service provider. A detailed design is made and the work is put out to tender. Construction of the infrastructure element follows, during which time construction drawings are available.

Once construction is complete, the as-builds are produced and are captured for inclusion in the existing system model.

**THE CHALLENGE**

Accurate and up-to-date models of the existing systems are required to evaluate the effect of any prospective large new demands or flows in the system. Checking the effect of new developments in this way allows the engineers to immediately see whether the existing infrastructure can handle the new loads or, if not, which measures should be taken to increase the capacity of the system.

Traditionally, in South Africa the process of producing a master plan for water and sewer infrastructure is repeated and updated every two to five years, depending on the rate of development in the study area.

Over the last decade there has been a government drive to provide basic services to all residents. This, together with a construction boom, has resulted in considerable development in certain areas of the country. It has been found that unless newly constructed infrastructure elements are captured regularly, the models of the existing systems soon become outdated.

Not only have the number of applications for development been significant, but it has been experienced that applications are being made to develop more houses or flats on a piece of land than was originally planned for. Once verified and accepted, these trends should be accommodated in future planning, with corresponding adjustments to the capacities of the planned infrastructure.
The challenge has been to develop a strategy to manage, capture and utilise information, keep the models up to date, plan for the future and revise the planning given new information. Up-to-date information should be available from the model at any time to facilitate decision-making for both the existing and future systems, allowing for prompt and accurate responses to queries and applications for new developments.

THE DYNAMIC MASTER PLANNING PROCESS

The dynamic master planning process has been developed to organise the flow of information between the various entities, as shown in the figure above. Without discussing all of the procedures and processes, which goes beyond the scope of this article, it can be stated that the primary aim of the dynamic master planning process is to maintain accurate models of both existing and future infrastructure requirements.

The existing system model is continuously updated by capturing and adding the as-built information as it becomes available. The future model is also continuously updated and adjusted with information regarding changes to the future development areas and with details obtained from projects which are currently being designed and constructed. As construction is completed and the as-builts are issued, the corresponding elements are moved from the future models to the existing system models. In the process all master plan items are regularly re-evaluated, along with the summary of costs and phasing in the master plan table. This in turn integrates with the project management software.

Because of the dynamic nature of the planning process and the large volumes of information it was decided that the reporting system should be paperless and integrated with the management information system. All information on the existing system, existing land uses, zoning, water sales and flows, future developments, future system and master plan items, projects and costs is presented in IMQS, a user-friendly GIS-based, but GIS-independent, management information system. Information and results are presented in IMQS in the form of pre-defined maps, graphs and tables, allowing for easy access for various levels of management and staff within the municipality.

Other important data which is used in the master planning process and which requires regular updating includes cadastral shape files, aerial photographs and digital terrain models. Additional output from the master planning includes plan books of the layout of the system with user required information, GIS shape files of the drainage areas and related information such as sewer flow, water demand and land use summaries. Summary tables of infrastructure upgrades and costs are also generated.

SOFTWARE

Wadiso and Sewsan are commercially available software packages used for the hydraulic modelling of water and sewer infrastructure respectively. Both products run within Albion, a GIS/CAD environment, which allows for clear visual interpretation of the systems, integration with other GIS and database information and high speed performance on large systems. These products were designed and developed by GLS Software (Pty) Ltd. Their close association with the engineering team of GLS Consulting (Pty) Ltd ensures that the products are continuously being improved so that both data capturing and system modelling are streamlined, accurate and efficient.

Swift was also developed by GLS Software (Pty) Ltd to process the water sales information from the treasury billing systems and link the sales directly to the models.

IMQS, the reporting software, was designed to graphically represent integrated asset infrastructure information. It specifically caters for the large volume of data resulting from the production of management reports and information made available by several products used for the roads, water, sewer, electricity and storm water master plans that had been created for hundreds of government and municipal authorities.

CONCLUSION

The authors have been involved with master planning for almost 20 years. The dynamic master planning process has evolved and is currently fully operational in the Tshwane Metropole, while parts of the process have been implemented for numerous other municipalities.

For more information on the software visit www.gls.co.za or www.imqs.co.za.

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- To Benjamin Harper for developing Albion, the GIS/CAD-based platform on which the modelling software runs
Berg Water Project

reserve releases

Implementation of the reserve at the Berg River Dam and Supplement Scheme

The Berg Water Project comprises the 65 m high Berg River Dam and the Supplement Scheme situated 12 km downstream that will pump water back into the dam during the winter months. The outlet works of the Berg River Dam were designed to release both the low flow reserve and the high flow reserve with provision for a peak release of 160 m$^3$/s. This is the first dam in South Africa with provision for both low and high flow reserve releases and these will be implemented for the first time during the winter of 2008. This article briefly describes the release tool which has been developed to assist the operators of the Berg River Dam to make the reserve releases.

TCTA, THE IMPLEMENTING AGENT for the Berg Water Project, appointed BRC (the Berg River Consultants – a joint venture of Ninham Shand, Knight Piésold and Goba) to undertake design and construction supervision. The project will be operated by the Department of Water Affairs and the additional yield it provides will be for the benefit of the City of Cape Town. Ninham Shand was appointed by the Department of Water Affairs (DWAF) to assist with the planning of the reserve releases.

PRELIMINARY RESERVE

The National Water Act of 1998 defines the reserve for basic human needs and the ecology. This is the quantity and quality of water that must flow in a river below a dam or other works to provide for basic human needs and to protect the aquatic ecosystems.

The main purpose of the reserve releases from the Berg River Dam is to maintain the aquatic ecosystems in the river below the dam. Therefore DWAF utilised the methodology developed by riverine ecologists, hydrologists, engineers and geomorphologists to determine the preliminary reserve for the Berg River Dam. The preliminary reserve prescribes the duration curves for the low flow releases from the Berg River Dam, the quality of the water released and also the durations and volumes of the high flow reserve releases, as follows:

- Daily average peak 65 m$^3$/s: 3 days = 10.11 million m$^3$ (160 m$^3$/s instantaneous peak)
- Daily average peak 30 m$^3$/s: 3 days = 4.67 million m$^3$
- Daily average peak 5 m$^3$/s: 3 days = 0.78 million m$^3$

DEVELOPMENT OF THE RESERVE RELEASE TOOL

Consultative process

The project team held a series of consultative meetings with the riverine ecologists who had been involved in the determination of the reserve to establish when the high flow releases should be made and the peak discharges of the smaller high flow releases known as freshets. The ecologists recommended the months in which various releases should be made, and the instantaneous peak flows for the freshets. It was also their view that the high flow releases should as far as possible coincide with natural flood events and that the temperature of the water released should be similar to that of the inflows to the dam.

Timing of high flow reserve release and design constraints

The practicality of making the high flow (or environmental flood) releases to coin-
cide with natural flood events, as recommended by the riverine ecologists, was discussed with the dam design team, the project authorities and the South African Weather Service (SAWS). The following constraints were identified:

- The high flow outlet works comprise an intake tower with inlets at three levels, an emergency slab gate, and an outlet conduit with a radial gate at the downstream end. The inlets to the tower can only be opened when the water level inside the tower is equal to that in the reservoir. The dam designers pointed out that the process of filling the outlet conduit could take some time. However, it was decided that this could be minimised by filling the 5,5 m diameter outlet conduit in advance but not the tower, as it would not be desirable to permanently pressurise the conduit.

- Extensive investigations were undertaken by Pegram and Associates to assess whether it would be possible to utilise the data from the SAWS radar on Constantiaberg to predict rainfall intensities in advance. This approach was abandoned on account of the very poor correlations between the radar results and the high-altitude rain gauges in the catchment. On the other hand, the rainfall predictions by the SAWS would provide the best indication of future storm rainfall events.

- In view of the uncertainties regarding storm rainfall predictions it was decided that high flow releases should only be made after the desired flood peaks have occurred. The effects of this on downstream flood peaks were assessed and it was agreed by the riverine ecologists that this approach was acceptable.

**High flow module of reserve release tool**
The high flow module of the reserve
A release tool was developed to assist the operator of the Berg River Dam to decide when a flood should be released, the shape of the hydrograph to be released and the intake to be used for the release. The tool will be installed on the operator’s PC and will assist him/her as follows:

- The sophisticated supervisory control and data acquisition (SCADA) system designed by BRC will also relay flow and temperature data from flow gauges upstream of the dam to the tool. These flows are combined and adjusted to determine the natural inflows to the dam and are displayed on an ongoing basis.
- The tool keeps track of the releases already made and one hour after the inflow peak has occurred it advises the operator if the inflow flood peak is sufficient for a particular release.
- The tool provides the operator with the facility to select the rising limb of the release hydrograph to match that of the inflow hydrograph and similarly the recession limb. The release peak of the release hydrograph can also be extended to match the inflow peak.
- The tool compares the volume of the proposed release with that required by the preliminary reserve and warns the operator if this is exceeded.
- The tool also provides the operator with a schedule of times, releases and gate openings to make the high flow release.

### Water Quality Module of the tool

The Water Quality Module of the tool utilises the CE-QUAL water quality stratification model to predict the temperatures in the reservoir during the release as follows:

- On an ongoing basis the SCADA system relays to the tool data on the temperature profile in the reservoir, the inflows and their temperatures.
- The CE-QUAL model uses this data and the proposed release hydrograph to predict the future temperature profiles in the dam and advises the operator which intake will best match the temperatures of the releases to those of the inflows.

### Low Flow Module of the tool

The Low Flow Module of the tool similarly monitors inflows and temperatures on an ongoing basis. It then utilises the natural duration curves and those for the reserve releases without high flows together with the water quality release module to recommend to the operator daily or weekly in arrears the intake to be selected, and the low flow releases to be made from the dam and the supplement scheme.

### CONCLUSION

The Berg River Dam is the first dam in South Africa from which it is required to make both low and high flow reserve releases. In particular, the release of high flows to coincide as closely as possible with the inflow hydrographs and temperatures of natural flood events necessitated the development of the reserve release tool to assist the operator. This tool assists the operator to select the appropriate intake and to prepare a gate opening schedule for high flow releases. The tool also assists the operator to plan the low flow releases by selecting the level of the intake and determining the release flows. The development of the reserve release tool required close cooperation between riverine ecologists and engineers.

Authors: Tente Tente – TCTA; Bertrand van Zyl – Department of Water Affairs and Forestry; Dr Mike Shand, Mlindi Makhabane, Ben Abban and Wageed Kamish – Ninham Shand Consulting Engineers

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**RESERVE RELEASE PROJECT TEAM**

**Beneficiary** City of Cape Town

**Clients** TCTA (Tente Tente) and DWAF Western Cape Region (Bertrand van Zyl)

**Dam designer** Berg River Consultants (BRC) (Ninham Shand, Knight Piésold & Goba)

**Consultant** Ninham Shand

**Project consultant** Mike Shand

**Project engineers** Mlindi Makhabane, Ben Abban and Wageed Kamish

**Environmental scientists** Cate Brown, Dana Gobler and Geordie Ractliffe
How has the ecological reserve influenced the design and operation of the Berg River Dam?

THE BERG WATER PROJECT (BWP) is the culmination of a 14-year strategic integrated planning process by the Department of Water Affairs and Forestry (DWAF) to identify appropriate measures to address the water shortage in the Western Cape. The planning process was initiated in 1989 and was called the Western Cape Systems Analysis (WCSA).

The purpose of the WCSA was to reconcile the water demand and water supply for the Western Cape region. The WCSA was a democratic public strategy process and was supported by technical and scientific assessment to aid decision-making. The water situation assessment conducted as part of the WCSA determined that the City of Cape Town (CCT) would be the first metropolitan area in South Africa where water demand would exceed the available water supply. The WCSA provided a list of projects that could be implemented to increase the water supply.

One of the key projects identified was the construction of a dam on the upper reaches of the Berg River. DWAF initiated the environmental impact assessment (EIA) process and the EIA report was produced for decision-making in 1996. The Department of Environmental Affairs and Tourism (DEAT) issued the record of decision (ROD) in 1999. The ROD stipulated that the dam should be designed so as to ensure flows for the ecological reserve. In addition, the ROD stipulated that if monitoring demonstrated that the dam had an unacceptable effect on the river, then the release pattern and ecological reserve quantity would have to be revised.

In April 2002 Cabinet approved the construction of the BWP on condition that the CCT reduces the demand for water by 20% by the year 2020. The BWP is the first bulk water resource development project that is directly linked to water demand management.

The BWP was the first large water resources infrastructure development project in South Africa to be designed, constructed and operated within the framework of the National Water Act and in accordance with the guidelines of the World Commission on Dams. The dam was therefore required to be able to make releases to satisfy all aspects of the ecological reserve as prescribed by the National Water Act.

WHAT IS THE ECOCLOGICAL RESERVE?
In the National Water Act (No 36 of 1998, chapter 3, part 3, section 16) the Ecological Reserve is defined as:

... the basic human needs reserve and the ecological reserve. The basic human needs reserve provides for the essential needs of individuals served by the water resource in question and includes water for drinking, for food preparation and for personal hygiene.

The Ecological Reserve relates to the water required to protect the aquatic ecosystems of the water resource. The Reserve refers to both the quantity and quality of the water in the resource, and will vary depending on the class of the resource.

In South Africa the terminology used for the provision of water of a suitable quality to protect the water resource is the ‘ecological reserve’. The term instream flow requirement (IFR) is also in common usage in South Africa and refers specifically to the flow requirement (both flow volumes and variability) to maintain a desired level of ecosystem functioning. Internationally other terms such as ‘environmental flow’ and ‘ecological flow’ are also used. Globally accepted definitions are based on the following two aspects:

- The quality, quantity and timing of water flows required to maintain the
components, functions, processes and resilience of aquatic ecosystems which provide goods and services to people.

- The foundation from which socially valued resources are derived and supported, and without which no sustainable use of the resource possible.

- A sustainable water resource and catchment management plan must be built upon a foundation of detailed scientific knowledge about the river flows (in terms of quantity and variability) and water quality needed to sustain ecosystem health and functioning. When the water needs of aquatic ecosystems (for example rivers, wetlands, estuaries and groundwater) are clearly defined by scientists, engineers and other professionals, water managers will be able to find ways of meeting human needs for water while maintaining adequate river flows for the ecosystem to ensure long-term sustainable use of the Berg River.

In South Africa, an aquatic ecosystem’s water needs are determined during an ecological reserve determination study. This is an environmental water requirement prescription which describes the necessary seasonal and inter-annual variation needed in low flows, high flows and floods, as well as the water quality requirement to support critically important ecological functions and for the continued provision of valued services.

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1. The Berg Water Project comprises the Berg River Dam (which is about 6 km west of Franschhoek) and the Supplement Scheme situated some 12 km downstream (which consists of a 1.6 m high diversion weir that will divert a portion of the winter high flows into a 3 ha off-channel balancing dam from where the water will be pumped via a 12 km pipeline back into the Berg River Dam).

2. The Berg River Dam is a concrete-face-rockfill dam type. The dam is 65 m high, 990 m wide and 220 m in width. The gross storage capacity of the dam is 130 million m$^3$. The outlet works have been designed to release both low flows and high flows with provision for a peak release of up to 200 m$^3$/s, making it the first dam in South Africa in which provision is made for flood releases for environmental purposes.

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The supplement scheme involves the diversion of winter high flows into a balancing dam from which the water will be pumped back into the Berg River Dam. The Berg River Dam, with a storage capacity of 130 million m$^3$, is a concrete-face-rockfill dam situated about 6 km west of Franschhoek. The outlet works are designed to release both low and high flows with a peak release of up to 200 m$^3$/s.
The ecological reserve provides for the maintenance of critically important aquatic attributes, goods and services (such as biodiversity, dilution capacity, habitat integrity, prevention of sedimentation etc.) and associated social services (such as fishing and water for river-dependent users and communities).

**WHAT IS THE ECOLOGICAL RESERVE FOR THE UPPER BERG RIVER CATCHMENT?**

The preliminary determination of the ecological reserve for the upper Berg River catchment for water quantity was set at 31.1% (that is, 44,061 million cubic metres) of the mean annual runoff of 141.7 million cubic metres.

For the ecological reserve determination, detailed background studies and a comprehensive analysis were undertaken of the historical flows for the upper catchment. In the determination of the ecological reserve, the duration curves for the low flow releases to be made from the Berg River Dam were determined and the high flow releases required were established to be as follows:

- Daily average peak 65 m³/s over 3 days = 10.11 million cubic metres
- Daily average peak 30 m³/s over 3 days = 4.67 million cubic metres
- Daily average peak 5 m³/s over 3 days = 0.78 million cubic metres

What this means is that the ecological reserve releases will be based on providing a portion of the natural flow contributions (or inflows to the dam) of the upper Berg River catchment for ensuring the continued functioning of the aquatic

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**BOX 1**

DWAF classifies water resources according to ecological categories. For some river systems, specific objectives have been set, for ecological, economic or social reasons. In such cases, ecological flows need to be defined to meet those objectives. The application of the objective-based approach necessitates first that the desired status of the river must be set. It then should be possible to define threshold flows above or below which a change in status will be evident. DWAF sets objectives, according to different ecological management targets. The determination and implementation of an ecological reserve is a practical river management mechanism, which enables the water resource to be maintained in its set category. For the Berg River, the ecological category was set as a category C.

**RIVER ECOLOGICAL CATEGORIES**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>Negligible modification from natural conditions. Negligible risk to sensitive species</td>
</tr>
<tr>
<td>B</td>
<td>Slight modification from natural conditions. Slight risk to intolerant biota</td>
</tr>
<tr>
<td>C</td>
<td>Moderate modification from natural conditions. Especially intolerant biota may be reduced in number and extent</td>
</tr>
<tr>
<td>D</td>
<td>High degree of modification from natural conditions. Intolerant biota unlikely to be present</td>
</tr>
</tbody>
</table>

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ecosystem below the dam.

According to the determination, the ecological category of the Berg River was set at C (see Box 1).

**HOW HAS THE ECOLOGICAL RESERVE INFLUENCED THE DESIGN OF THE BERG RIVER DAM?**

The requirement to implement the ecological reserve has dictated that the Berg River Dam be designed to cater for two distinct flow release systems, that is, small releases and large releases. The system for small releases occurs in the range 0.3 m$^3$/s to 12 m$^3$/s. These releases occur continually and are adjusted in magnitude as required by the ecological reserve and depending on the inflow into the Berg River Dam.

The radial arm gate system for large flows is able to make releases up to 200 m$^3$/s. These large flow releases will mimic naturally occurring flood events. The system for large flood releases is purely as a requirement of the ecological reserve and is unique. The system consists of a wet well in the intake tower, a concrete conduit through the dam wall and control gates.

**HOW WILL RELEASES FROM THE DAM BE MADE TO MEET THE REQUIREMENTS OF THE ECOLOGICAL RESERVE?**

- No base flow and high flow releases will occur out of phase with inflows into the Berg River Dam
- Environmental flow releases to meet the requirements of the Reserve will comprise the summer and winter base flows of 4 m$^3$/s on average in June, July, August and September and the winter high flow releases of up to 160 m$^3$/s
- During the summer months inflows into the dam will be released to supply the ecological reserve
- Flood events of different magnitudes will be made each year to simulate the natural inflow patterns into the dam. This includes floods with an average daily peak of 65 m$^3$/s and a maximum instantaneous peak of 160 m$^3$/s. The outlet structure of the dam is designed to allow the instantaneous peak to be increased to 200 m$^3$/s. Dam releases will be operated in phase with the natural flood events
- High flow releases from the dam will be no greater than the inflows into the dam, in other words these would coincide with the magnitude of natural events
- During periods of drought the magnitudes of the reserve releases would be reduced

**CONCLUSIONS**

Compliance with the requirements of the ecological reserve is expected to achieve the following benefits:

- Maintain the Berg River in Ecological Category C
- Maintain the river ecosystem to continue to provide users with acceptable water quality and an ecosystem that can support the living organisms in it
- Prevent increased sedimentation in specific areas downstream of the dam (for example at Paarl)
- Ensure that release patterns occurs as close to the natural flow variability as possible (for instance for inter- and intra-annual floods and wet and dry-season low flows)

The Berg River Dam is unique and is the first large in-stream dam in South Africa that is required to make both low and high flow (flood) ecological reserve releases. The dam will be operated to ensure that the releases of low flows and high flows coincide as closely as possible with natural inflows and natural flood events.

References are available on request
IN MAY 2005 THE DEPARTMENT of Water Affairs and Forestry (DWAF), Directorate: National Water Resource Planning commissioned the Outeniqua Coast Water Situation Study (OCWSS), which was completed in December 2007.

The need for the study was driven by the fact that a number of towns in the study area were experiencing serious periodic water shortages, mainly because of substantial growth in urban water usage; high ecological reserve requirements associated with the ecologically important coastal rivers; insufficient yield of the existing water sources; and inadequate capacity of the bulk water supply infrastructure. These shortages have resulted in prolonged water supply restrictions, which impact on the potential for future economic growth. Certain municipalities have imposed moratoria on the approval of new developments, pending the implementation of water source augmentation projects.

The purpose of the OCWSS was to investigate the nature and the extent of the water balance problems in the area, to identify the problematic areas and to evaluate possible reconciliation strategies needed to alleviate the yield deficit and to make adequate provision for the ecological Reserve, taking into consideration the current and future situation in the more seriously affected areas, such as the Mossel Bay, George and Knysna municipalities.

OVERVIEW OF THE STUDY AREA

The study area covers about 7 000 km² of land in the coastal belt between Stilbaai and Knysna, which is bounded by the Goukou River catchment to the west, the Noetzie River catchment to the east and the Outeniqua and Langeberg mountain ranges to the north. The area falls under the jurisdiction of the Eden District Municipality and includes significant portions of the Hessequa, Mossel Bay, George and Knysna municipalities.

The total population of about 285 000 (2005) is expected to grow to about 700 000 in 2025 and resides predominantly in urban settlements. The additional seasonal population is estimated at 360 000 (2005) people, which results in exceptionally high seasonal peak water requirements.

The economy is characterised by significant agricultural developments, associated with crop production and afforestation. The only large industrial development of note is PetroSA near Mossel Bay. A notable increase in golf course developments has been observed during recent years, with 17 new developments in the process of implementation.

The study area is drained by 14 perennial rivers, which flow into the Indian Ocean. From a hydrological perspective, the study area covers portions of primary drainage regions H, J and K and is subdivided into 29 quaternary catchments.

The area forms part of the Gouritz Water Management Area (WMA) and covers portions of its Gouritz and Coastal sub-catchments.

The runoff in the study area is currently regulated by 42 large dams with a total storage capacity of about 65 million m³. In addition, the area includes an estimated 11 300 small privately owned farm dams with a combined storage capacity of about 56 million m³.

WATER REQUIREMENTS AND LAND USE

A summary of the estimated present and projected future water requirements per user sector for the entire study area is provided in table 1. The distribution of the water requirements between key catchment areas is illustrated in figures 1 and 2.

The urban and rural water requirements were estimated on the basis of the methodology developed for the National Demographic Study (Schlemmer et al., DWAF, 2001). Provision was made for the water requirements associated with the additional seasonal population and all known planned developments, including golf courses and other housing projects. Various scenarios with regard to population and economic growth were developed and evaluated.

Detailed desktop studies were undertaken to determine the present and projected future land-use for irrigation, farm dams, afforestation and invasive alien...
plants (IAPs) and various scenarios with regard to their future growth were evaluated. The information was used to model the water requirements and to update the hydrological model for the study area.

The area under irrigation is projected to increase from 397 km² in 2005 to 451 km² in 2025. The irrigation is mostly opportunistic, supplied from small farm dams and run-of-river abstraction works. As a result of that, the assurance of supply is relatively low, about 60%.

The area of the existing forestry plantations in 2005 has been estimated at 472 km². For economic reasons, in 2000, the large forestry growers in the area considered withdrawing significant portions of their plantations. However, in recent years these plans have changed owing to the substantial growth in demand for timber. Forestry managers have recommended that the best practice would be to assume that the present plantation size would remain unchanged until 2025.

The condensed area covered by IAPs is estimated to increase from 221 km² in 2005 to 478 km² in 2025. IAPs are widespread throughout the study area, but the most severe infestation is evident in the catchments of the Klein Brak, Great Brak, Maalgate, Gwaing, Kaaimans and Wolwe rivers, which cover most of the Mossel Bay, George and Knysna municipal areas.

### SURFACE WATER RESOURCES

The stream flow analysis for the study area was undertaken using the Water Resources Simulation Model 2000 and the simulated runoff sequences were calibrated against flow records from 12 flow-gauging stations. Land use, infrastructure and water use data sets were updated. The naturalised and 2005 MARs for the study area were estimated at 777 million m³/a and 558 million m³/a respectively.

The Water Resources Yield Model (WRYM) was used to determine the individual yields for the major dams in the study area. Various scenarios with regard to the ecological water requirements (EWR) were also modelled.

The water sources for the Mossel Bay Regional Water Supply Scheme (RWSS), which include a number of large dams (the Wolwedans, Klipheuwel, Ernst Robertson and Hartbeeskui dam) and run-of-river schemes (Kleinbos Weir and

### Table 1 Consumptive water requirements per user sector for the study area

<table>
<thead>
<tr>
<th>User sector</th>
<th>Water requirements (10^6 m³/a)</th>
<th>Distribution, % of total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005</td>
<td>2025</td>
</tr>
<tr>
<td>Urban domestic</td>
<td>32.3</td>
<td>56.56</td>
</tr>
<tr>
<td>Rural domestic and stock watering</td>
<td>6.42</td>
<td>7.4</td>
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<td>Industrial</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Irrigation</td>
<td>166.93</td>
<td>193.84</td>
</tr>
<tr>
<td>Afforestation</td>
<td>63.04</td>
<td>63.04</td>
</tr>
<tr>
<td>Invasive alien plants</td>
<td>38.7</td>
<td>85.7</td>
</tr>
<tr>
<td>Total consumptive requirements</td>
<td>312.99</td>
<td>412.14</td>
</tr>
</tbody>
</table>
Searles Furrow), are largely interlinked and interdependent. For that reason, these schemes were modelled as a combined system and the system operating rules were optimised.

The system WRYM for the Mossel Bay Regional Water Supply System was configured to include all existing sources, as well as three additional future water source development options, which include the raising of the existing Klipheuwel Dam, the construction of the proposed Bottelierskop Dam on the Moordkuil River, and the construction of a large farm dam on the Variers River. In order to test the sensitivity of the yields, the system was analysed for a number of scenarios, which were composed on the basis of different combinations of the water sources and provision for the EWR.

The yield from all existing sources with no provision for EWR is estimated at 24.3 million m$^3$/a. For EWRs of 1 million m$^3$/a and 6 million m$^3$/a for the Great Brak Estuary, the system yield is reduced by 1.49 million m$^3$/a and 3.58 million m$^3$/a, respectively. If the ecological reserve for the Moordkuil River is implemented in future, the yield will be further reduced by 3.18 million m$^3$/a. The Klipheuwel Dam, an off-channel dam close to the Moordkuil River, is an existing scheme and the full EWR for the Moordkuil River is at present not supplied.

**Groundwater Resources**

From a regional perspective, the groundwater recharge is estimated at 351 million m$^3$/a. Of this, an estimated 141 million m$^3$/a discharges into rivers as the groundwater contribution to base flow and 210 million m$^3$/a is potentially available for abstraction. The groundwater resources in the study area are currently not being utilised to their full potential, as the present groundwater use is estimated to be only in the order of 9.21 million m$^3$/a.

A local-scale investigation was undertaken to assess the potential for development of groundwater sources to supply either alone, or in conjunction with surface water sources, the water requirements in specific areas. The investigation concluded that groundwater would be a feasible source of supply of the long-term peak requirements for Albertinia, Buffelsbaai, Sedgefield, Stilbaai, Gouritzmond, Vleesbaai and Boggomsbaai.

Limited exploration drilling was undertaken in the Mossel Bay area (quaternary catchment K10A). The results confirmed and exceeded the projections made during the desktop study.

**Yield Balance**

The yield balance for the study area was modelled using the WRYM. The term ‘yield balance’ is defined as the difference between the assured yield of the water resources and the water requirements in a specific area.

Separate ecological reserve determination studies are currently being undertaken by DWAF’s Directorate: Resource Directed Measures (RDM) in order to obtain a better understanding of the ecological water requirements of certain sensitive rivers and estuaries.

The yield balance estimates were undertaken for a number of scenarios based on variations of two parameters, namely the land and water use (present or future scenario) and water sources, for which the yields were determined. In all instances the EWRs were considered and determined on the basis of either the desktop model or as provided by DWAF: RDM. The present-day yield balance for the study area is estimated to be in deficit of about 1.3 million m$^3$/a. If no additional water source developments are implemented in future, this deficit will increase to 28.3 million m$^3$/a by 2025. The distribution of the yield balance between key catchment areas for the years 2005 and 2025 is illustrated by colour coding in figures 1 and 2.

Even if all presently known proposed surface water development options are implemented, the yield balance in 2025 will still be in deficit of about 8.4 million m$^3$/a. The development of alternative sources such as groundwater, desalination of seawater and the use of treated effluent is therefore required.

**Reconciliation Strategies**

The water supply situation in the Mossel Bay and Hessequa municipal areas was assessed during the course of this study and possible options for the reconciliation of the water requirements with availability were developed and evaluated. The George and Knysna municipalities recently completed feasibility studies, which evaluated various options for the augmentation of the existing sources of supply for their main water supply centres. The recommendations for all areas are briefly summarised below.

**Mossel Bay Municipality**

The water requirements for all users supplied by the Mossel Bay RWSS are estimated to grow from 16.8 million m$^3$/a in 2005 to 23.8 million m$^3$/a in 2025, while the total licensed allocation for the system from all existing water sources is 15.6 million m$^3$/a. The system is already in deficit of about 1.2 million m$^3$/a, which is expected to grow to about 8.2 million m$^3$/a in 2025. However, it was estimated during the OCWSS that there is a surplus yield of about 5 million m$^3$/a available from the Wolwedans and Klipheuwel dams which has not been allocated yet. Various water source development options were assessed and the recommendations for reconciliation interventions are:

- The DWAF should increase the allocation for Mossel Bay Municipality from the Wolwedas Dam from 2.34 million m$^3$/a to 5.8 million m$^3$/a.
- The municipality should undertake a project to develop and implement a comprehensive Water Conservation and Water Demand Management (WC/WDM) strategy and programme.
- The municipality should undertake a feasibility study to identify, evaluate and implement possible supply-side interventions to reconcile the water requirements with water availability. The study should consider the development of groundwater sources, the raising of the Klipheuwel Dam, the construction of the Bottelierskop Dam on the Moordkuil River, the use of treated effluent for irrigation, industrial and potable use, and the desalination of seawater.

**Hessequa Municipality**

Measures to augment the existing source of supply to Riversdale are required. Hessequa Municipality should undertake a study to reconcile the yield of the Korentepoort Dam with the allocations for all users. If surplus yield is available, the municipality should apply for licensing of additional abstractions. The study should also investigate options to increase the yield of the dam by raising of the dam wall and/or clearing of IAPs in its catchment to increase run-off, as well as an investigation into the availability of groundwater sources.

Desktop investigations undertaken during the course of this study have revealed that there is high potential for further development of the groundwater sources to meet the future water re-
requirements for Albertinia, Stilbaai and Gouritzmond. The municipality should undertake further studies to develop additional groundwater sources in these areas.

**George Municipality**

George Municipality should undertake the following actions:

- A comprehensive WC/WDM study and implementation of all feasible intervention
- Further studies and implementation of the following most feasible surface water source development options: revitalisation of the Kaaimans Weir scheme (already completed), combined with the raising of the Garden Route Dam and the implementation of the Malgas Dam scheme
- Further studies to select the most feasible development options, which will be required to meet the requirements beyond 2022

**Knysna Municipality**

Knysna Municipality should undertake the following actions regarding the augmentation of the water sources for the Knysna RWSS:

- Expand the existing WC/WDM interventions, identify and implement further interventions
- Raise the Akkerkloof Dam and increase the pumping capacity from the river
- Investigate the refurbishing/upgrading of the Charlesford/Eastford pumping scheme to utilise the full permitted capacity
- Investigate and implement the best scheme, which will provide storage on or near the Knysna River
- Investigate the feasibility of further use of treated effluent for irrigation
- Undertake further investigations and develop groundwater sources
- Water source augmentation options for other towns in Knysna Municipality are:
  - **Sedgefield** Possible augmentation options include the run-of-river abstraction from the Hoëkraal River, the construction of an off-channel storage dam at the farm Swartrivier and the development of groundwater
  - **Rheenendal** Augmentation options include the clearing of IAPs in the upper reaches of the Homtini River catchment, the construction of an off-channel storage dam at the farm Suurvlakte and/or the development of groundwater sources
  - **Buffelsbaai** The development of groundwater has been identified as the obvious solution for the augmentation of the existing water source. Potential drilling targets to the north of the town have been identified
- **Karatara** The development of a new run-of-river abstraction works on the Karatara River, close to the town, has been identified as a possible water source augmentation option. The existing bulk water supply infrastructure needs to be upgraded

**CONCLUSIONS AND RECOMMENDATIONS**

- The ecological reserve requirements are the key for the determination of the available system yield and yield balance in the area. When the results from the current reserve determination study undertaken by DWAF become available, they should be used to update and refine the conclusions of the OCWSS regarding yields and yield balances
- DWAF should undertake further studies to verify the allocation and lawful water use for irrigation and to update and refine the estimated areas covered by irrigation, afforestation and IAPs
- IAP clearing projects in the area appear to have huge potential for preservation of the water resources
- In order to enhance future hydrological modelling, DWAF should refurbish certain flow-gauging stations in the area, which yielded inadequate flow records
- The groundwater resources can play a meaningful role in addressing many of the water supply challenges in the study area
- All municipalities in the study area have implemented some WC/WDM interventions. However, the municipalities should undertake the necessary formal and comprehensive WC/WDM studies, identify specific goals, and develop and implement a defined and structured WC/WDM strategy and programme to reduce their water requirements

**PROJECT TEAM**

The study was undertaken by UWP Consulting (Pty) Ltd, in association with BKS (Pty) Ltd, as the lead professional service providers, supported by various sub-consultants and DWAF directorates providing specialist services.
The likelihood of a global drought in 2009–2016

SOUTH AFRICA IS CURRENTLY experiencing a severe energy crisis that has widespread consequences on all sectors of our society. Blame is being levelled at the South African authorities for not heeding earlier warnings that shortages would develop if additional power stations were not built to meet the rapidly rising demand.

It takes between five and ten years to plan, design and construct large power stations. Coal-burning and nuclear power stations are the only option on the required scale. Restricting use through the imposition of electricity rationing appears to be the only immediate solution. This is likely to continue for at least the next five years. This is already having severe adverse effects on South Africa’s economy.

There is the possibility of an equally severe event occurring before the

Abbreviations used:
IPCC – Intergovernmental Panel on Climate Change. This United Nations body was established in 1988 and produces five-yearly assessment reports. Its latest series of reports were published during 2007. A shortened synthesis report for decision-makers was distributed during the Bali Conference in November 2007. It is the reference used in these notes.
GHGs – Undesirable greenhouse gas emissions, principally carbon dioxide. It is claimed that these emissions from coal-burning power stations, transport and industrial activity are causing increases in global air temperatures. These in turn are predicted to cause a whole series of undesirable consequences including increases in floods, droughts and environmental damage.
energy crisis is resolved. This is the likelihood of the occurrence of severe drought sequences of a magnitude equal to that of the Great Depression drought of the 1930s. They are likely to commence within the next 12 months, reach their peak two or three years later, and continue through to 2016.

Consider the consequences. There will be shortages of cooling water for the inland coal-fired power stations for a start. This will exacerbate the energy crisis just at a time when things start improving. Then there will be all the other consequences for agriculture, rural communities and water supplies generally. Together with the present energy crisis it will be a national disaster of enormous consequences.

What is the likelihood of this occurring?

THE EARTH’S CLIMATE

The earth’s climate is driven by the receipt and redistribution of solar energy. If global scale climatic changes are observed, the investigation into the most likely cause should begin with an examination of the concurrent variations in solar activity. The fundamental issue is the separation of the effects of human activities from natural variability.

Numerical quantifications of the natural variability of rainfall, river flow and open water surface evaporation (but not temperature) are the very essence of water resource analyses; flood magnitude/frequency analyses; and natural disaster mitigation studies. Those of us who are active in this field have a professional responsibility to assess and report on the effects of human activities on these processes should they be present.

The most important (critical) data set in climate change studies is the reconstructed global annual surface air temperatures since 1850. These are the foundations of the IPCC reports. This data set is not publically available despite its critical importance. I managed to obtain a copy. The annual sunspot data are from the website http://sidc.oma.be/DATA/yearssn.dat that I used for my earlier analyses. I now had two parallel sets of annual data from 1850 to 2006.

The first exercise was to plot the temperature data. The result is in figure 1. The temperatures are the deviations from 14 °C. This is almost identical to the temperature graph in figure SPM.1 in the IPCC’s synthesis report distributed at Bali. The sharp upward trend since 1980 and the sustained high values during the past six years are also very clear. This is the graph that the IPCC relies on for evidence of human causality of global warming. The argument is that this graph is proof of a causal linkage between increasing GGEs and increasing global temperatures.

There are serious problems with this conclusion. Not only has there been no sustained increase in global temperatures since 1998, but during the past year global temperatures have shown a marked decrease. This is causing panic among the climate change fraternity.

For reasons that remain a mystery, the IPCC failed to take the obvious next step. Could this increase be the consequence of a concurrent increase in solar activity? This is extremely important, as the solar linkage has to be eliminated before this temperature increase can be attributed to human activities.

It was a simple matter to produce Excel graphs that showed both the temperature and sunspot data and the corresponding linear trend lines. It is common practice in preliminary time series analyses to split the record into two parts and examine them separately. The year 1913 is the beginning of the first double sunspot cycle during the past century and a convenient point to split the data.

The two data sets were analysed. While during the period 1913 to 2006 both the sunspot numbers and the global temperatures showed increasing trends, during the earlier period 1850 to 1912 both the global temperatures and sunspot numbers decreased during this 62-year period.

Given the above information, it would be a very brave scientist who continues to claim that there is NO linkage between variations in global temperatures and corresponding variations in sunspot activity. Even more importantly, the IPCC scientists were negligent, bordering on irresponsible, not to carry out these simple analyses that go to the very core of climate change science, and need only a few

<table>
<thead>
<tr>
<th>Table 1 Solar periodicity table</th>
</tr>
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<tbody>
<tr>
<td><strong>Period year</strong></td>
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<tr>
<td><strong>Periods</strong></td>
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<td><strong>1</strong></td>
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<tr>
<td><strong>2</strong></td>
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<td><strong>24</strong></td>
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</tbody>
</table>
What then is an appropriate time unit for examining the relationship between variations in solar activity and global air temperatures? The obvious candidate is the length of the double sunspot cycle. In the analyses that follow, we are simply using a solar-related time unit. In principle this is a logical extension from a 24-hour day, to a 365-day year, to a 21-year solar period.

PREDICTABILITY

The cyclical and therefore predictable behaviour of sunspot activity is beyond all doubt. It has also been known for more than 100 years in South Africa that there is a synchronous linkage between sunspot numbers and South African rainfall and river flow. As explained in ‘Linkages between solar activity, climate predictability and water resource development’ (Alexander et al 2007) the alternating sunspot cycles are causally related to the acceleration and deceleration of the sun as it moves through galactic space.

SCALE DEPENDENCE

It was obvious from the analyses that a synchronous relationship exists between sunspot activity and global air temperatures of effort using readily available computer software.

Table 2: Annual sunspot numbers

<table>
<thead>
<tr>
<th>Period year</th>
<th>1843</th>
<th>1867</th>
<th>1889</th>
<th>1913</th>
<th>1933</th>
<th>1954</th>
<th>1976</th>
<th>1996</th>
<th>Lowest</th>
<th>Highest</th>
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<td>1</td>
<td>10.7</td>
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temperatures on a multi-decadal scale. Yet much has been made of studies that showed that variations in received solar energy were too small to account for the observed climate variations. The authors then erroneously assumed that no causal relationship existed. Their studies failed to address the well-documented historical linkages that demonstrate the presence of this synchronous behaviour. Why did the IPCC scientists deliberately omit mention of this information? The most likely reason is that these scientists used annual time scales in their studies, not realising that their conclusions were scale dependent.

What then is an appropriate time unit for examining the relationship between variations in solar activity and global air temperatures? The obvious candidate is the length of the double sunspot cycle. In the analyses that follow, we are simply using a solar-related time unit. In principle this is a logical extension from a 24-hour day, to a 365-day year, to a 21-year solar period. The difference is that the length of the solar period is not precise but varies within a narrow range. The reasons are given in the joint paper referred to above.

### SOLAR PERIODICITY TABLE

The years during which the sunspot minima associated with the double sunspot cycle occurred are readily identified in the annual sunspot data. These, together with the number of years between them are as follows: 1843 (24) 1867 (22) 1889 (24) 1913 (20) 1933 (21) 1954 (22) 1976 (20) 1996 (21) 2017.

It was now possible to produce a solar periodicity table that will allow any time series data to be rearranged and analysed using the solar period as a basic time unit. This is shown in table 1.

It is a simple matter to substitute the available data values for each year, and carry out the analyses in Excel. Table 2 shows the sunspot data for each year in the solar periodicity table.

Each column in the table begins with the year in which the solar minimum associated with the double sunspot cycle occurred. The data were analysed row by row and then plotted in the periodicity graph (figure 2).

Note in particular the difference in the distribution of the sunspot numbers and their ranges in the alternating cycles.

### PERIODIC BEHAVIOUR

Table 3 is based on information in P D Tyson’s book *Climate change and variability in southern Africa*. It was published in 1987 – a year before the establishment of the IPCC. It must be stressed that the interest is in sequences of years, not individual years. This is where other researchers made a fundamental mistake. They searched for linkages between solar activity and climate on a yearly basis instead of a periodic basis. When they could not detect it they assumed that no linkage was present.

It is a simple matter to construct table 4 from this information. It shows the years in which the double sunspot cycles commenced in the left-hand column and the period year numbers in the top row. The grouping of wet and dry sequences and the correlation with the double sunspot cycle is even clearer than before.

Compare this information with figure 2 above. Note the dominance of wet years associated with the first sunspot cycle (years 1 to 11), and dry years with the second sunspot cycle (years 12 to 22). The association of the alternating sunspot cycles with the wet and dry periods is very clear. It is a suitable basis for the prediction of the likelihood of drought sequences in the years ahead.

### Table 3 Periodic range of wet and dry rainfall sequences (after Tyson 1987)

<table>
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<th>Years</th>
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</tr>
<tr>
<td>1944–1952</td>
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<td>1933–1943</td>
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<td>Wet</td>
</tr>
<tr>
<td>1905–1915</td>
<td>Dry</td>
</tr>
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</table>

### Table 4 Periodic behaviour of South African rainfall

| Period starting | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|-----------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1996            |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1889            |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
Drought alert

It is important to note that periodicity in the data was used as the prediction tool and not the sunspot cyclicity.

Figure 3 is a river flow prediction model prepared by Alwyn van der Merwe. It shows the periodic dam inflows for ten sites in the South African interior. For each record, the average for each period year was determined using the method described above. These period year averages were then plotted in the figure. The process was repeated for the remaining sites.

We are at present in period year 13 (2007–2008). Note the very clear, well above average recorded river flows for the present hydrological year (13). Even more importantly, note the succession of below average river flows in the period years that lie ahead (14 to 20). Analyses of other long hydrological data series show similar characteristics.

This prediction model is based on the thoroughly studied, synchronous linkage between periodic solar activity and the hydro-meteorological processes. It has been tested and verified. The likelihood of prolonged, severe droughts from next year onwards is very real.

Can we venture an estimate of how severe the droughts are likely to be?

There were five dry (drought) sequences during the past century. One of them was the Great Depression drought. As a first estimate there is therefore a 20% likelihood of it being repeated in the years ahead.

As I write these notes there is a considerable volume of international Internet traffic expressing concerns relating to the lack of solar activity during the past year and the possibility that the world may be entering an ice age. While this may be premature, the linkage between the abnormally cold weather being experienced in the northern hemisphere and the abnormal lack of sunspot activity during this period is causing considerable concern.

All indications are that we are now on the threshold of global cooling associated with the second and less active solar cycle. The delayed solar minimum occurred earlier this year (January 2008). A severe global drought will almost certainly be one of the consequences.

Reference

This article should be studied in conjunction the paper by Alexander, Bailey, Bredenkamp, Van der Merwe and Willemse, Linkages between solar activity, climate predictability and water resource development, Journal of the South African Institution of Civil Engineering, Vol 49 No 2 June 2007, pages 32–44, Paper 659, and the references therein.
Towards sustainable development
Achieve development potential, support key ecosystems and provide poverty relief

CLANWILLIAM DAM, a mass gravity structure with thirteen crest gates, is located on the Olifants River in the Western Cape near the town of Clanwilliam and the Cederberg mountains.

The dam wall is 43 m high and the storage capacity of 122 million m$^3$ is only about 30% of the present-day mean annual runoff. Water stored in the dam is mainly used for irrigation. The Lower Olifants River Government Water Scheme (LORGWS) supplies raw water from Clanwilliam Dam and Bulshoek Weir to farmers, municipalities, mines, and industries in the Olifants River Valley between the dam and the estuary.

There is a requirement for a better assurance of supply for agriculture from the LORGWS and demand for further water allocations. There is also pressure to allocate additional water to resource-poor farmers in this area, to alleviate poverty and address the need for water sector reform.

In order to comply with the current dam safety standards concerning extreme flood events, the Department of Water Affairs and Forestry (DWAF) plans to implement remedial measures in the near future. These would involve major construction works and present an opportunity to raise the dam and thereby increase its yield.

Figure 1 shows Clanwilliam Dam and figure 2 shows Bulshoek Weir, which is located 30 km below the Clanwilliam Dam on the Olifants River.
AIMS OF STUDY
The aim of the feasibility study was to verify the technical, environmental, social, economic and financial viability of raising Clanwilliam Dam. The study also aimed to determine the optimal height for such raising, if found to be viable. Four raising options, namely no raising (0 m), and 5 m, 10 m and 15 m raisings were considered. Other options for increasing supply volumes for irrigation, including clearing invasive alien vegetation, reducing system losses, agricultural water demand management, and the use of groundwater (from fractured rock aquifers of the Table Mountain Group) were evaluated to ensure that the DWAF is aware of the full range of alternatives and their implications. Figure 3 shows the bulk water infrastructure of the LORGWS.

ECOLOGICAL NEEDS AND YIELD ANALYSIS
A comprehensive reserve (basic human needs and ecological water requirements, EWRs) assessment for the Olifants/Doring rivers was completed in 2006. Recommendations from the study, which focused on the riverine and estuarine ecological water requirements, were taken into account in the feasibility study.

The natural mean annual runoff of the Olifants River above Clanwilliam Dam is 356 million m³/a. Average supply from the LORGWS over the last 25 years was estimated as 174 million m³/a, but during droughts the supply was curtailed. Farmers currently receive water at an unacceptably low assurance of supply, estimated to be around the 1.5 year level of assurance.

Data on land use and agricultural demands, farm dam capacities and the extent of invasive alien vegetation in the catchment upstream of Bulshoek Weir were updated as part of this study. Various scenarios were analysed, using the Water Resources Yield Model, to determine the historical yields of the system for the existing (unraised) dam and for three dam raising options. The scenarios investigated also took account of the influence on yield of making releases from Clanwilliam Dam to meet the EWRs downstream of the Bulshoek Weir and at the estuary. Yields were determined at various levels of assurance of supply for the current dam and the three dam raising options.

WATER QUALITY ASSESSMENT
The impacts on thermal stratification and release temperatures of raising the dam wall were modelled, as well as the mitigating effects of installing a multi-level outlet structure.

The water quality requirement is predominantly a temperature constraint due to the spawning requirements of the Clanwilliam yellow fish downstream of the dam. The temperature of water released from the dam should be within the range of 18–24 °C during the months of October to January. It was concluded that as water in the dam will stratify during the summer months any raising of the dam wall should be accompanied by the construction of a multi-level outlet structure to release water of the appropriate temperature to meet the downstream requirements. This would to some extent offset the impacts on aquatic life of the reduced flows in the downstream river during the winter months.

DAM DESIGN
The design philosophy took account of the likely deterioration of the prestressed cable anchors and was based on providing long-term structural stability, minimal operational requirements, predictable operation and minimal maintenance requirements. Alkali-aggregate reaction had been identified on the surface of the current structure but it was concluded that this did not significantly lower the engineering properties of the concrete. A number of options for improving the stability and raising the dam were analysed and preliminary designs were prepared to an acceptable level of detail. The method of raising proposed is to remove the crest gates and bridge and to construct an integral mass concrete structure against the downstream face of the existing mass gravity dam. The construction of a multi-level outlet works may potentially involve coring through the existing wall. Ogee and labyrinth outlet configurations were assessed.

Map of existing LORGWS bulk water infrastructure
OTHER SUPPORTING TECHNICAL INVESTIGATIONS
Soils, water requirements and crops
A soils map was compiled for the Olifants River Basin from Keerom, south of Citrusdal, to the coast. An expert system approach was used to evaluate the potential of the different soil types for the production of annual and perennial crops. Based on these evaluations it was clear that the availability of land with suitable soil for irrigated agriculture is not a restrictive factor for the expansion of irrigation activities, although some soils limitations would have to be ameliorated. The irrigation water requirements of deciduous fruit, citrus and grapes were determined for the various regions and various climatically adapted crops currently grown in the study area, as well as suitable alternative crops, were identified.

Financial viability of irrigation farming
The financial viability of existing irrigation farming was evaluated, as well as the viability of expansion in the different regions of the Olifants River System, by utilising the additional irrigation water from the potential raising of Clanwilliam Dam. The existing irrigation farming practices in the various regions of the study area are relatively capital-intensive and risky, but the financial analyses indicated that these are economically viable. On account of the capital-intensive requirements of the farming practices it will be generally be more viable to expand existing farms than to develop new irrigation farms, although in some areas development of new irrigation farms would be viable.

Socio-economic implications
The Olifants River Valley is characterised by significant disparities in income and social circumstances, with many workers only being seasonally employed. Both the Cederberg and Matzikama municipalities are characterised by vast areas of rural, agricultural and conservation land, with small urban centres. Poverty is particularly high in the rural areas. The chief economic activity is agriculture. Some individuals and activities will benefit from the dam raising, while others will be either temporarily disrupted or permanently affected in a negative way. Therefore a socio-economic impact assessment was undertaken to analyse and to weigh these affects against each another. It was determined that the positive impacts would far exceed the negative impacts.

The social benefits arising from the raising of Clanwilliam Dam will be important for the poverty alleviation strategies in the study area. Jobs, new sources of income and opportunities for economic advancement will be created. With adequate support in terms of access to transport, training and funding, the project could result in significant improvements in the overall standards of living.

Irrigation development and water distribution options
The options for productively and cost-effectively distributing and utilising the additional water that will be made available through the raising of the dam
were investigated and costed. A range of water uses and options for distributing water for agricultural and other uses were considered and evaluated and it was found that although it would be beneficial to improve the assurance of supply to users served by the LORGWS canal system, it would not be economical to increase the capacity of the canal system. Measures to reduce system losses were also investigated and recommended.

Resource-poor farmers

The potential raising of Clanwilliam Dam offers a unique opportunity to make water available to address some of the social challenges by supporting water allocation reform. Ways were identified to utilise the additional yield made available by the dam raising to meet these objectives and to ensure that the available natural resources of the area are used to the greatest benefit of society.

The main conclusion from this evaluation was that there is potential to use water to support the development of historically disadvantaged individuals in the area, but that the solution is not a single large-scale resource-poor farmer scheme. Instead a suite of development options was proposed. The proposed development options will require significant engagement by the DWAF and close cooperation with other spheres of government to ensure their success. Key to this will be to develop a clear mandate on how the water will be allocated.

Financial evaluation

Capital costs (based on 2006 costs) were determined for making the dam safe for extreme flood events (0 m for dam safety), as well as for raising the dam by 5 m, 10 m and 15 m. Unit reference values (URVs) were determined for the various dam raising options for discount rates of 4 %, 6 % and 8 %. The URVs were based on the capital costs of the three raisings less the capital cost of making the dam safe. For a discount rate of 6 % the lowest URV is for the 9 m raising. A 15 m raising would have a URV of R 0,45/m³. Incremental URVs were also determined. The incremental cost of raising the dam from 13 m to 15 m would be particularly high, especially for the higher discount rates.

Environmental authorisation

A full environmental impact assessment process was undertaken to investigate, describe and assess the potential environmental impacts of the proposed project and to provide recommendations regarding the potential for mitigation of impacts, and how the positive impacts could be enhanced. A range of specialist supporting studies was undertaken, including vegetation, freshwater fish, hydrogeological, infrastructural, social and heritage assessments and reserve extrapolation from nearby sites.

The impacts on the existing roads and other infrastructure surrounding the dam basin will depend on the height of the raising. Portions of the N7 national road to the west of the dam would need to be relocated, as well as sections of secondary roads. It would likely be too expensive to relocate a section of Divisional Road 2183 along the eastern bank of the dam.

As scheduled activities require authorisation from the Provincial Department of Environmental Affairs and Development Planning (D: EA& DP), the environmental impact report was submitted to D: EA& DP in October 2007 for their review and decision.

KEY RECOMMENDATIONS

Raising

■ DWAF recommends that Clanwilliam Dam be raised by constructing an integral mass concrete structure against the downstream face of the existing mass gravity dam. The method of construction and the type of spillway will be established during the detailed design phase.

■ A multi-level outlet structure must be built for all dam raising options to ensure that the water quality and temperature requirements of the downstream aquatic habitat can be satisfied.

■ A raising of 13 m appears to provide the maximum benefit at acceptable cost. The incremental URV of raising the dam from 13 m to 15 m would be unacceptably high compared with the likely cost of any future bulk water development in the catchment (most likely groundwater).

■ The 13 m raising would provide a yield of 70 million m³/a, after allowing for the implementation of the ecological Reserve, at a capital cost of R365 million (2006 costs).

Water use

■ DWAF should ensure that as much of the water made available from the raising of Clanwilliam Dam as practically possible is utilised for transformation and poverty alleviation in the area.

■ In order to ensure the equitable distribution of the benefits from the raising of the dam, a multi-stakeholder Olifants/Doring River Development Agency or other relevant implementation vehicle should be established.

■ The further identification of suitable farms or projects to potentially take up any additional water can to a large extent be left to the implementing agency and the potential users, however resource-poor farmers would need specific support.
VRESAP to be operational by November

The Vaal River Eastern Subsystem Augmentation Project (VRESAP), also known as the Vaal Pipeline Project, is being implemented to meet the growing water demands of Eskom and Sasol in the Mpumalanga Highveld region. The scheme will transfer water via a 121 km pipeline from the Vaal Dam near Vaal Marina to the Knoppiesfontein diversion structure which discharges into either the Trichardtsfontein or Bosjesspruit dams near Secunda. VRESAP will augment the yield of the Vaal River Eastern Subsystem (VRESS) by 160 million m³ per year.

CABINET APPROVED VRESAP on 6 October 2004. On 26 November 2004 the Minister of Water Affairs and Forestry, in terms of section 103(2) of the National Water Act (No 36 of 1998), directed TCTA to fund and implement VRESAP.

In terms of clause 24 of the revised notice of establishment published in Government Notice 21017 of 24 March 2000, TCTA may perform any additional functions required in terms of a directive by the Minister of Water Affairs and Forestry under section 103(2) of the National Water Act. VRESAP is a separate ring-fenced project without a government guarantee, implemented and financed by TCTA. The borrowings are in TCTA’s name with recourse against the income stream from the project.

PARTNERSHIPS

Two agreements set out the institutional arrangements between DWAF and the main users, Eskom and Sasol (agreement 1) and DWAF and TCTA (agreement 2). These agreements were signed in October 2005.

Agreement 1 sets out the terms and conditions of supply from DWAF to the users, as well as the terms and conditions of payment by the users of all raw water delivered.

Agreement 2 sets out the terms and conditions relating to the implementation of the project and the payment by DWAF to TCTA for bulk raw water delivered. TCTA’s credit exposure is therefore to DWAF and not to the users.
GOVERNANCE AND FUNDING

TCTA’s board is ultimately responsible to the Minister of Water Affairs and Forestry and to Cabinet for the implementation of VRESAP. The VRESAP Technical Committee accommodates the participation of TCTA’s partners (Eskom, Sasol and DWAF) in implementing the project. An independent engineering panel reviews all technical implementation aspects of the project and makes recommendations to the committee. The long-term funding process for VRESAP was finalised by the signing ceremony of the loan agreements on 24 January 2006.

PROJECT PROFILE

The augmentation project for the transfer of water into the VRESS – a sub-system of the integrated Vaal River system – will involve the installation of a pumping system to convey raw water from a new intake at the Vaal Dam to an upgraded Knoppiesfontein diversion structure. The abstraction point at the Vaal Dam is approximately 1 000 m upstream from Vaal Marina. The upgraded diversion structure at Knoppiesfontein will be able to convey and divert raw water pumped from the existing Grootfontein Pump Station.

The components of the project include:
- An abstraction works, including balancing facilities, at Vaal Dam
- A high-lift pump station, capable of delivering 5.4 m³/s
- An upgraded Knoppiesfontein diversion structure
- Some 115 km of 1 900 mm nominal diameter (subsurface) all welded steel pipeline
- Six kilometres of 1 200 mm nominal diameter steel pipeline from Knoppiesfontein to Bosjesspruit Dam
- Air ventilation valves and scour chambers (above surface) at intervals along the pipeline route

The total yield of the pipeline is 160 million m³ per annum.

PROJECT ENGINEERING Contracts

The professional design and supervision functions for the project are provided by a consortium of local civil engineering consultants operating under the name
A new abstraction works is being built to extract water from the Vaal Dam. The abstraction works consists of an approach channel excavated underwater in rock and a concrete shaft of close to 25 m deep – comprising intake structure and low lift pump station. Two sets of three low lift pump units draw water from the intake and discharge it through a 1.9 m diameter, 800 m pipeline into three balancing dams where silt in the raw water is allowed to settle, ensuring the required quality.

High lift pump system

Downstream of the balancing dams the water is led into a series of high lift pumps each with its own booster pump. Booster pumps are provided to create allowable suction pressure for optimum performance of the high lift pumping system. The high lift pump system delivers the water to a level in the region of 350 m higher at a rate of 5 400 litres per second.

The pipeline

The system will pump water from the Vaal Dam through a 1.9 m diameter pipeline to a surge tank located 54 km away near Greylingstad. A surge tank has been constructed along the pipeline to provide protection against damage in the pipeline system caused by high pressures generated from the sudden opening or closure of valves in the system, or failure of the pumping system.

**Diversion structure**

From the surge tank, approximately 190 m above the Vaal Dam water level, water flows downhill to the diversion structure at Knoppiesfontein near Secunda. The diversion structure is essentially a large tank from which the water discharge is split to flow in either the direction of Bosjesspruit Dam nearest to the Sasol facility or to the Trichardsfontein Dam nearest the Eskom power plant.

The pipeline runs through largely agricultural land and is buried between 1.2 m and 7 m deep, depending on the terrain. Pipe jacking has been used where the pipeline crosses other existing national infrastructure such as roads and railroads. After completion of construction, normal activities shall resume above the pipeline, except that no structures may be built directly above the pipeline.

Where the pipeline travels under streams and in close proximity of settlements measures are taken in order to minimise the impact on the environment and communities.

**ENVIRONMENTAL MANAGEMENT**

Environmental authorisation

In order to obtain the requisite environmental authorisation for the implementation of VRESAP, TCTA procured the services of independent consulting environmentalists and public involvement specialists to conduct the environmental impact assessment (EIA) and public involvement process in March 2005. The EIA report was submitted to DEAT in July 2005. Having reviewed and accepted the report, the department issued a record of decision (RoD) in September 2005, authorising the project. Completing the EIA process and obtaining the RoD in this relatively short time was a major achievement for TCTA. Aware of the immense time constraints, the VRESAP team decided to prepare an EMP as part of the EIA process. This approach achieved the desired outcome and with the issuing of the RoD, the EMP was also approved. The requirements of the EMP were translated into detailed environmental specifications in the various contracts to ensure that construction impacts are contained and mitigated as far as possible.

**Environmental Monitoring Committee (EMC)**

The EMC was constituted and held its inaugural meeting in March 2006, and has continued its work as environmental ‘watchdog’ for the entire project.

**Nurseries for indigenous plants**

One of the requirements of the EMP was the rescue of indigenous rare and endangered plants from construction areas. The plants were identified prior to construction and removed to a nursery established to care for the plants until completion of construction activities, when the plants will be used in the rehabilitation of the project area. This nursery has also provided employment and developed skills in the project area.

**PROJECT SUSTAINABILITY**

Target percentages have been defined for the various contracts:

- To maximise employment opportunities for the local communities
- To minimise the utilisation of imported labour within the ambit of applicable legislation
- To maximise contracting, training and development opportunities for local businesses, HDI-owned businesses and SMMEs so as to ensure maximum procurement opportunities
- To give effect to this policy, each contract awarded on the VRESAP stipulates employment, training and procurement targets. The performance of the contractor against the targets is monitored on a monthly basis
- The project has provided some 750 temporary jobs during construction and 20 permanent ones during the operation and maintenance phase

**CHALLENGES**

According to Paul le Roux, the VPC project manager, a number of significant challenges were associated with the project:

- The compilation and coordination of the tender documentation was extremely complicated as a result of significant changes made to the initial preliminary design report recommendations
- An engineering solution for the abstraction works in the Vaal Dam.
Underwater blasting and dredging is required to remove over 10 000 m³ of material and create a suitable approach channel. As the underwater blasting skills are not readily available in South Africa, an international specialist subcontractor is required.

The site of the permanent abstraction works had to be shifted because of unforeseen geological conditions, thus delaying this component of the works and entailing the design and commissioning of a floating temporary abstraction works to ensure water delivery by the contracted date.

The selection of appropriate pipe line material. The combination of different grades of steel was investigated. The use of Grade X65 steel plate was initially a concern because of the lead times required to stabilise the metallurgical consistency. Successful completion of recent export contracts by Mittal addressed this scheduling concern. An alternative to steel was ductile iron imported from France. The many joints and potential leakage, exchange rate fluctuations and severe time constraints on supply eventually eliminated this alternative.

Managing the manufacture, supply and installation of the 1 900 mm diameter continuously welded steel pipe has been a key factor for project success. Mittal has had to supply on average 11 coils of steel per day to two pipe manufacturers that converted the coils to 19 m long pipes at a rate of 24 pipes per day.

Electrical and mechanical works are normally modular with design being undertaken by the contractor in some instances while in a normal civil environment, design is normally done by the employer. Paul le Roux explained that approximately 20% of the VO21 contract value is mechanical/electrical work that is integrated within the civil contractual environment.

The COVEC component of the C-MC contract are managed almost exclusively by Chinese engineers and foremen with varying degrees of English proficiency and project management skills, thus complicating all communication channels on site. Workshops were held early in the contract to facilitate a mutual understanding of the cultural and management differences and thereby facilitate project progress.

The fast-tracked nature of the project required highly stringent quality control on site.

COMMISSIONING OF THE WORKS

The commissioning of the project is set to commence in August with the works being ready for operations and water delivery in November this year.
SKUKUZA REST CAMP in the Kruger National Park will be the venue for the 10th International Water Distribution System Analysis (WDSA) conference which will take place from 17 to 20 August 2008.

The conference, known as WDSA2008, is hosted by the University of Johannesburg and is officially sponsored by Rand Water. It is a particular honour for South Africa that the 2008 WDSA conference will be the first in the WDSA series to be hosted outside the USA.

The main objectives of the conference are to provide a forum for water distribution professionals to interact and share knowledge, stimulate scientific collaboration, encourage and foster debate on new ways to supply and manage drinking water systems, and bring together researchers and practitioners from developing and developed countries. Specific themes for WDSA2008 include all aspects of water distribution system modelling and application, including system reliability and security, water demand, water quality, leakage management and water supply in developing countries. The call for abstracts attracted over 140 submissions from around the world. Of these, 120 were selected for presentation at the conference in three parallel sessions. WDSA2008 will without doubt be the foremost specialised conference on water distribution systems in the world this year, attracting world leaders on various aspects of water distribution systems. Besides the support of SAICE, WDSA2008 is endorsed by the following organisations:

- American Society of Civil Engineers
- International Water Association
- International Association of Hydraulic Research
- UK Institute of Civil Engineers
- Department of Water Affairs and Forestry
- Water Institute of Southern Africa
- Institute of Municipal Engineers of Southern Africa

The unique location of Skukuza created a number of challenges for the organisers that required innovative thinking to solve. A major challenge was that Skukuza does not have a venue that can hold the more than 200 delegates expected at the conference. For this reason, the conference opening and keynote address will be held on the Sunday evening in the Skukuza amphitheatre. This will be followed by a meet-and-greet function around large bonfires.

Delegates will be given ample opportunity for game viewing and networking. The conference programme allows for early morning and late afternoon game drives when game viewing is at its best. On the Monday evening, an optional night game drive is offered, followed by a bush braai and a talk on the stars in the southern hemisphere. The conference dinner on the Tuesday evening will be held at the Skukuza golf club with guest speaker Willem Botha, a professional game ranger and award-winning photographer. On the last afternoon of the conference, a behind-the-scenes tour of the civil engineering challenges in the Kruger National Park is planned.

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The Galaxy Panel reservoir offered an affordable, safe and efficient water storage solution to the Ntabaskop and Insiminya Community Water Supply Scheme’s increasing water loss problems.

During early 2003 the Umgeni Water Operations Division experienced difficulties in coordinating water balancing checks in the Ntabaskop and Insiminya areas due to severe water leakages in most of the ferro-cement reservoirs within the reticulated network. In a combined attempt to investigate and resolve the situation, the Umgeni Water Design Support Division was tasked to prepare a comprehensive report together with recommendations of repair, refurbishment or replacement. Ntabaskop is situated in the Ndわdwe magisterial district approximately 40 km north-west of the town of Verulam, in KwaZulu-Natal, and falls within the jurisdiction of the Ilembe District Municipality.

The original reticulation scheme was constructed in 1994 as part of a labour-intensive project funded by the then Port Natal-Ebdwe Joint Services Board. The second phase was undertaken in 1998 as part of the Reconstruction and Development Programme (RDP) funded by the Department of Water Affairs and Forestry (DWAF).

The reservoirs were of varying sizes ranging from break pressure tanks of 1 000 ℓ, 50 kℓ and a number of 100 kℓ and 200 kℓ structures. The basic construction method of all the ferro-cement reservoirs was the same: they were circular with dome shaped roof designs, wall heights of 2.1 m and 80 mm thick, reinforced with 3.6 mm x 100 mm mesh placed two layers back to back. The reservoir floors were of 5.6 mm x 200 mm square mesh covered to form a 100 mm thick concrete floor slab.

Close investigations of the reservoirs revealed that their failure was largely attributed to substandard and shoddy workmanship, characteristic of many labour-intensive RDP projects of the time. The larger cracks over the entire structure could have been due to weak concrete mixes. The difficult terrain, hills and poor site access, compounded by very limited access to good clean water and raw materials, are guaranteed to have contributed to these failures.

The urgency to repair these reservoirs was further compounded by a need to transfer ownership of the reservoirs from the Local Water Committees (LWC), supported by Umgeni Water to the newly appointed Water Services Authority (WSA) and Water Services Provider (WSP), Ilembe District Municipality. Before any transfer could be undertaken, the reservoirs had to be presented in a fully operational and leak free condition to the Ilembe District Municipality.

The results of the investigation done by Umgeni Water were made known and included many thoroughly researched options, amongst others, use of cementitious repair products; use of bituminous torch on and paint on methods of repair; and bladder-type liners to be installed inside ferro-cement tanks.

All the above were deemed ‘temporary’ and ‘unsatisfactory’, as they provided no lasting warranty/guarantee. The idea of replacing the reservoirs was then proposed as a longer-term more proactive method of approach consists and included the following possibilities:

- **Pressed steel tanks**: These were found to be exorbitantly expensive and required the tank to be position on base supports which were too difficult to achieve given the difficult terrain and limited space available on some sites.
- **Prefabricated concrete reservoirs**: This particular construction method consists of installing a series of in-situ vertical concrete columns interspaced with pre-cast concrete walling on a concrete base, with all joints sealed with a bitumen sealant to render the tank waterproof. These are usually roofed with galvanised roof sheeting. This reservoir design was not considered, for various reasons: tanks need high load access roads to site, leading to considerable extra project expense with construction possibly hampered by difficult terrain; ongoing maintenance is required by these reservoir types; and there always needs to be water in the tank.
- **Galaxy reservoirs**: as supplied, installed and commissioned by SBS Water Systems (Pty) Limited of Pinetown, KwaZulu-Natal, was the recommended option for various reasons, including the following:

  - Being the most economical option, more than R450 000 cheaper than pre-fabricated concrete and as much as R930 000 cheaper than pressed steel.
  - It was the only option to offer a ten-year non-leak guarantee. This was welcomed by the Ilembe District Municipality, who had seen the limited reliability of reinforced ferro-cement reservoirs which had lasted less than ten years.
  - The Galaxy reservoir was able to be constructed on the existing ferro-cement floor/base, requiring minimal site preparation and concrete work.
  - Ease of assembly and construction meant that all reservoirs could be replaced without constructing new roads.
  - The contract period is short and delivery speedy.
  - Should the end user so desire, the reservoirs can be increased in volume or dismantled and re-assembled elsewhere.

**Refurbish, repair or replace?**
In a record period of less than three months the 17 failing ferro-cement reservoirs were demolished, the existing floors levelled where necessary, and new Zincalume Galaxy panel reservoirs with Aqualiner installed and commissioned. Thanks to using Galaxy reservoirs the stakeholders were able to bring the project in on time and within the limited budget available to them. As a result of this successfully completed project, the Ilembe District Municipality now use Galaxy reservoirs on numerous of their water supply projects.

Galaxy reservoirs are now available throughout South Africa as well as other African countries through of an extensive distribution network.

INFO

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WHILE THE PLATINUM mining industry continues to enjoy a boom phase, mines in the water-scarce Eastern Limb face a challenge in water management never before experienced in mining in South Africa.

The Eastern Limb is in a region that incorporates Polokwane and Burgersfort, where some 12 mining operations are producing platinum for the world market.

According to Peter Shepherd, principal hydrologist and a partner with SRK Consulting, mines in the Eastern Limb aim to produce 1 tonne of ore mined using 1 000 litres of water, or less.

He said SRK Consulting had been providing services to the mining industry in South Africa for 30 years and the extent of the challenges being faced in the water-scarce Eastern Limb had set new boundaries.

‘There is a lot in the planning phase. The South African Department of Water Affairs is planning a number of transfer schemes and the development of bulk water infrastructure to supply the mines, but this is yet to be put in place,’ he said. ‘It is envisaged that more water will come from the Olifants River, with an increase in the height of the Arabie Dam. The proposed construction of a new dam in an environmentally sensitive area on the Steelpoort River upstream of the Kruger National Park would also help alleviate water needs.

‘Billions of rands will have to be put into projects to supply the mines with enough water in the future,’ he said. ‘Mines in the Eastern Limb are managing at present but we will have to continue reassessing where water is available and how we will transfer it to the mines. This is an extremely tough challenge.

‘An increase in water supply to the Eastern Limb is much dependent on whether or not these projects will proceed,’ he said.

Shepherd added that four years ago, SRK Consulting designed and was responsible for the construction management of a weir on the Olifants River, near Lebalelo, as well as of a pipeline to supply a number of mines in the Eastern Limb with water. Today, SRK Consulting is providing services to most of the mining operations in the region to ensure the optimum use of available water.

‘We have examined various alternatives to supply clients at different stages with enough water. We also assist with trying to minimise the amount of water that a mine needs by reducing water losses from a mine. We try to reduce the water make up by using less water, by creating fewer areas for evaporation, reducing seepage, and determining where water can be re-used.

‘This helps in two respects; reducing the take-off from the river to make up the water supply and reducing pollution to the environment. Instead of water discharging to the environment it is re-used. Today this is the main focus of all mines,’ he said.

Water is becoming a scarce commodity and the National Water Act (No 36 of 1998) requires mines to focus on water management especially since the introduction of Regulation 704 of the Water Act in 1998.

‘The mines are endeavouring to use a maximum of 1 000 litres per tonne of ore mined, with the ultimate objective of reducing this to 200 litres,’ he said. ‘Tough targets have to be achieved because mining cannot continue if there is no water.’

Shepherd said SRK Consulting has a team of about 40 people who are employed exclusively in the management of water in mines in South Africa. They are concerned with surface water, ground water, quality of water and legal compliances at the mines.

Regulation 704 of the Water Act required mines to manage water effectively, and to avoid contamination of the environment. Contaminated water has to be reused in the mine and cannot leave the mine property. However, loss of water on a mining property can escalate to 50 % of the water delivered to the mines, mainly due to evaporation, he explained.

Asked whether the mining operations are meeting the requirements of the Act he said most mines are working towards this within time tables set by the department for compliance. Audits are also mandatory to ensure compliance within five to ten years.
CONSTRUCTION OF PHASE 1 of the Eastern Cape’s Mbashe North water supply project – which includes the water treatment works on the banks of the Mgwali River – is nearing completion.

The Amathole District Municipality, which appointed Stemele Bosch Africa (SBA), to design and implement this water supply scheme, originally anticipated this project would provide potable water to about 35 000 people living in the immediate area.

‘The project has since been extended to include additional communities, which means ultimately, about 63 000 people will receive potable water from this scheme,’ says André Naudé, director of SBA, part of the B & A Group. ‘It has been challenging to efficiently phase the scheme and to design a water treatment works that can be
easily augmented to cater for the increase in water demand as future phases are connected to the scheme.’

The R29-million Phase 1 water treatment facility will initially treat 3.8 Mℓ/ℓ, with an ultimate capacity of 7.6 Mℓ/ℓ.

The treatment facility and associated works for Phase 1 include a raw water intake structure, pump station and reservoir, a 315 mm diameter uPVC pumping main, mixing channel and sedimentation tanks. The project also encompasses rapid gravity filters, a clear-water reservoir, pump station and water tank, as well as wastewater and sewers gravity pipelines. Sludge ponds, access roads, security fencing and chemical dosing buildings are also being constructed. SBA is responsible for both the commissioning and installation of electrical and mechanical equipment.

Local communities are benefiting from this project, which is providing desperately needed employment in the area as new skills are being learned and transferred to the community. It is anticipated that by completion of Phase 1, over 22 000 manday jobs will have been created in an area where little opportunity for employment exists. This financial injection impacts positively on households in this poverty stricken area.

Phase 2, which consists of the construction of the rising main, is due for completion in August 2008.

INFO

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1. Phase 1 of the Eastern Cape’s Mbashe North water supply project – which includes the water treatment works on the banks of the Mgwali River – is nearing completion.

2. The Amathole District Municipality, which appointed Stemele Bosch Africa (SBA), to design and implement this water supply scheme, originally hoped to provide potable water to about 35 000 people living in the immediate area. The project has since been extended and will ultimately provide potable water to about 63 000 people.
Reservoir built with hollow-core precast concrete slabs

A South African first

LINDLEY, A SMALL TOWN in the eastern Free State, is where South Africa’s first complete reservoir (wall and roof) using precast hollow-core concrete slabs was erected.

A skills shortage, especially of concrete specialists and shuttering expertise, led to a decision to extend precast slab technology, which has already been successfully used on reservoir roofs, to the walls. Besides negating the skills shortage, opting for the precast route meant substantial cost and time savings, while simultaneously guaranteeing consistency in the quality and requisite properties of the walls.

The Lindley reservoir forms part of the government’s programme of bringing water and water-borne sanitation to all South African communities. At a capacity of 1,2 Mℓ, the reservoir will supply 950 housing units that are to be erected on the outskirts of Lindley in the course of 2008/09.

Johann Steyn of MVDXariep Consulting Engineers, the company responsible for the design and project management, said the walls took a mere three days to erect.

‘Had we opted for traditional shuttering it would have required four 1,2 m lift sections, each of which would have taken about seven days to complete. On this basis the whole project would have stretched over six weeks had we been well equipped and had access to the necessary skills. As things stood at Lindley, it would have taken much longer, as neither condition applied.

‘Being the first of its kind, this project involved a learning curve for all participants. Even so, the entire project only took seven weeks to complete. And, provided all the precast material is to hand, future reservoir projects using precast slab technology on the walls, columns, beams and roofs should take no more than ten days to complete once the in-situ floor has been constructed,’ said Steyn.

The in-situ concrete floor at the Lindley reservoir took three weeks to construct. It comprised a reinforced concrete outer ring beam 400 mm wide x 500 mm deep and projected 300 mm above the concrete floor to provide adequate shear resistance to the reservoir walls. The 150 mm thick reinforced concrete floor was cast in four strips and the joints were sealed with horizontally positioned rubber water stops.

Wall slabs were supplied by a CMA member company, Bloemfontein-based Stabilan. Based on hollow-core prestressed technology, each wall slab measures
1,2 m x 4.5 m x 250 mm thick and is rated at a compressive strength of 50 MPa. However, unlike traditional slabs which are fully hollow-core, the lower 1,2 m of each slab was cast in solid concrete to provide additional shear strength. Once installed, the joints between the slabs were grouted and a horizontally positioned steel strap measuring 90 mm x 8 mm was fastened 1,200 mm from the top of the wall to provide ring tension to the upper section of the wall panels. The inside of the walls were then lined with 30 mm thick gunite and painted with a waterproof sealant from Multi Chemical Construction.

An additional vertically positioned rubber water stop was also installed along the bottom of the inner slab wall. It was covered with gunite, half of which was imbedded into the floor to prevent leaking through the bottom of the wall panels.

Precast roof slabs, in various lengths, 1,2 m wide and 160 mm thick, were supplied by Stabilan to cover the 17 m diameter reservoir. They are supported by the precast walls on the circumference as well as two beams which divide the reservoir into three sections. Each beam is in turn supported by three columns. Measuring 330 mm x 330 mm and 330 mm wide x 1,200 mm deep respectively, the columns and beams were constructed from masonry with infill concrete in order to make use of the local bricklayers. The beams and columns could have been replaced by precast components manufactured by Stabilan.

After being placed into position, the roof slabs were grouted and covered with a cement screed 100 mm thick at the centre of the reservoir and 50 mm thick at its perimeter, thereby creating a 50 mm drainage slope.

Steyn commented further that the quality control of concrete in water retaining structures is all important. ‘On-site concrete mixing requires a full-rime supervisor to ensure that the quality is of the right quality and consistency and this certainly applied at Lindley.’

Steyn believes that many more such reservoirs are likely to be constructed as the government’s water and sanitation programme gains momentum.

‘I believe precast slab technology will come into its own, especially in small towns and rural centres where the expertise for shutter work is simply not available. A different situation applies in the cities where each project should be evaluated on the basis of available skills and equipment at any given time.’

In addition to the new Lindley reservoir, a 150 kℓ sectional steel pressure tower was erected close to the reservoir. The tower, which consists of a galvanised steel tank on a steel frame, rises to 9 m at its apex. It was installed to feed the surrounding higher-lying areas which, due to a lack of water pressure, cannot be adequately supplied by the reservoir. The reservoir and the water tower are supplied by electronically controlled pumps which, in turn, feed all the other reservoirs in Lindley.

Following a path of least resistance, the pump fills the concrete reservoir first. However, an over-riding system of electronically controlled valves has been installed to ensure that, when necessary, water can be pumped into the water tower before the reservoir.

CMA director John Cairns comments that the Lindley reservoir project is further evidence of the versatility of precast hollow-core slab technology.

‘Precast concrete is still underutilised in the country, but engineers are becoming increasingly attuned to its advantages, as this project clearly demonstrates,’ says Cairns.

South Africa’s first reservoir with precast hollow-core concrete slabs is being constructed at Lindley in the Free State.

The completed 1,2 Mℓ Lindley Reservoir, with a 150 kℓ sectional steel pressure tower positioned behind it.
Ensuring solid foundations for the FIFA World Cup’s flagship stadium

DURING THE INITIAL STAGES of work at Soccer City, there was a flurry of activity with GEL’s piling rigs installing around 1 300 piles with a diameter of between 600 mm and 1 500 mm to depths of up to 30 m around the stadium. Work began on this fast-track project in mid-March 2007 and was due for completion by the end of May 2008. As foundations are completed, the Grinaker-LTA/Interbeton Joint Venture, to whom GEL is subcontracting, moves in to progress construction further.

Piles are being installed inside the stadium to support the seating as well as around the perimeter for specially designed foundations to shaft columns supporting the stadium roof. These latter foundations are between 1 200 mm and 1 500 mm in diameter and have been designed to accommodate massive uplift forces. To counter these forces, it has been necessary to drill through ducts left in the piles into underlying bedrock and install ground anchors.

Exceptionally difficult ground conditions at the site have posed a considerable challenge to GEL, said GEL’s Mark Laidlaw. ‘We had to drill through layers of quartzite and sandstone boulders to ensure stable founding. To do this we brought in the most powerful auger piling rigs in the country – a Casagrande B200 and a Soilmec R620 – which have torque capacities of 20 ton metres.’

There were five piling rigs on site at peak and 13 000 m³ of concrete will have been used for 20 000 m of piled foundations.

ACCESS TUNNELS
As well as foundation piling, GEL is installing lateral support for three access tunnels to the soccer field.
Creating the 4 m wide, 50 m long tunnel on the west side was more complicated because it had to be excavated underneath the existing grandstand. The tunnels on the north east and south west sides, however, allowed easier access. GEL was responsible for soil nailing and gunniting the lateral support to the excavation faces which are up to 9 m deep.

Approximately 5 000 m² of lateral support will be provided by GEL for the tunnels together with the basement for the parkade adjacent to the west side of the stadium.

The foundation piles and lateral support have been designed by ARQ Consulting Engineers, and the site is being ably managed by GEL’s project manager, Alan Scott.
Potable water reservoir under construction

THE WIDER PORTIONS of the Roodepoort and Randburg areas within Johannesburg Water’s (JW) area of service have been supplied by water from the Rand Water’s Meredale System, and specifically through direct feeds from the 1 000 mm diameter F34 pipeline linked to the Waterval Reservoir Sub-system. At the termination of the F34 pipeline, Rand Water owns a vacant site where the three main Rand Water meters supplying Randburg (JW’s Boschkop, Honeydew and Randpark Ridge zones – BHR) are situated.

With the current and anticipated growth rate within the BHR zones and beyond, it was resolved that the F34 pipeline would need to be augmented by the end of 2008. A final analysis conducted indicated that it was cheaper to construct a reservoir than to bring the augmentation of the F34 pipeline forward. In addition to these, operational problems were experienced at the Waterval Reservoir during periods of high demands in October/November 2005, thus indicating the need for supplementary storage within the sub-system.

To review the demands in the BHR water district and beyond with a view to optimising usage of the new reservoir by the benefiting municipalities, regular discussions were held between Rand Water and Mogale City. Both JW and Rand Water have investigated the options for maximising the use of the Weltevreden Reservoir and integrating it within the existing system without compromising the current level of service. Further expansion to the proposed Weltevreden Reservoir System was also mentioned and investigated to a limited stage. Both JW and Mogale City have indicated support for the reservoir and were satisfied with the proposed operating expansion methodology. JW has subsequently provided Rand Water with the estimated current and future water demands for the Weltevreden Reservoir System, including the Mogale City demands. Also in 1998, the Western Metropolitan Council (currently JW) purchased storage to the capacity of 2,3 Mℓ from the proposed Weltevreden Reservoir. The site of the reservoir is within Rand Water’s fenced property in Christiaan de Wet Drive between John Vorster Avenue and Rinyani Road in Randburg and comprises 24,8 ha of land on the crest of a hill. The boundaries of the site are next to private residences.

A fairly good basal vegetation layer has developed on the site with several grass species present and large stands of exotic trees.

An environmental study was conducted of the site and project as a whole and an environmental scoping report and environmental management plan were prepared which provide detailed mitigation measures for identified impacts.

DESIGN

The design is generally in accordance with the recommendations of the British Standard Code of Practice BS 8007 and BS 8110 as well as BS 5896 and SABS 1200.

The reservoir is situated close to the crown of a small hill, with the ground sloping away in all directions, at a gradual slope ranging between 2,5 % and 5 %. The site is underlain by granitic rocks of the Basement Complex as exposed in the Johannesburg – Pretoria Dome. The reservoir is sunk into the ground and the perimeter walls are backfilled so that approximately the top metre of the reservoir only will be visible at the end of construction. With a plan area of 12 170 m², the reservoir has 187 columns supporting a post-tensioned prestressed roof. The floor is also for the most part post-tensioned with the sloping portion of the floor being flat at approximately 20 degrees from the horizontal. The perimeter wall is a reinforced concrete wall of the cantilevered type 4,5 m high.

A freeboard of 610 mm is provided above the full supply level and provision is made to accommodate an overflow rate of 87 Mℓ per day with the water level 195 mm above full supply level. The working water depth of the reservoir is 12,5 m. Flexible jointing of the various structural elements allows the structure to accommodate differential movements and expansion joints are provided every 31 m. The walls were designed in modules of 15,5 m length and a conventional heel-and-toe cantilever retaining wall was used.

The 600 mm diameter columns at 7,750 m centres go up to the underside of the 200 mm thick roof slab over which is a 2,0 m square upstand of 150 mm height. The bases of the columns are supported directly onto the floor slab, which is 200 mm thick. The floor slabs slope towards a central drainage channel to facilitate cleaning of the reservoir. The post-tensioned roof slab, 200 mm thick, has a 150 mm thick layer of 50 mm store covering it as a temperature insulation layer.

Below the floor and wall sections, a compartmental drainage system was put in place, consisting of an 80 mm thick no-fines layer of concrete placed over a geofabric to prevent hydrostatic build-up. Nine compartments drain separately to facilitate the tracing of leaks.

Water is fed into the reservoir via a 1 600 mm diameter steel pipe running through the wall above the floor slab. The pipe is supported on pedestals and inside the reservoir changes from a steel to a GRP pipe which is routed to some distance before taking a right angled turn and extending further away. Extraction is via a sump some distance away and opposite to the position of entrance of the pipe through the wall. This routing of the inlet pipe ensures circulation of the water.

Construction started in May 2007 and the reservoir is due for completion in March 2009.
Cape Town Container Terminal’s R4.2 billion expansion programme is moving full steam ahead since commencing mid-January 2008, despite early delays from the strong ‘Cape Doctor’ wind which hampered the terminal’s productivity earlier this year.

Transnet’s Port Terminals Business Unit Executive, Oscar Borchards, said subcontractors at the country’s second largest container terminal were working hard to meet the port operator’s forecast capacity improvement from 740,000 TEUs to 1.4 million TEUs by the end of 2012.

‘We are currently blasting hard rock and initial earthworks are in progress. Danish subcontractor Rohde Nielsen has also completed soft dredging works at berth 601 as part of the move to enable larger vessels to pass through the harbour,’ says Borchards.

The key aspects of the project are:
- Construction of a deeper terminal with new quay wall suitable for Super Post Panamax cranes
- Replacement of the old ship-to-shore cranes with Super Post Panamax cranes with twin lift capability
- Increasing stack capacity by moving from straddle carriers to a rubber tyred gantry crane (RTG) operation

A crane erection site will be assembled at the terminal during 2008. The site will be used for the delivery and assembly of two new Liebherr ship-to-shore cranes that are scheduled to arrive in June 2008. Eight new ship-to-shore cranes will replace the current fleet of four Demag and two Noell cranes at the terminal, while half of the new Liebherr fleet is expected to be in place by December 2008.

Before the end of 2008, the terminal marshalling yard will be converted to a staging area.

The deepening of the first berth, 601, is expected to be completed in February 2009. It will swing into operation at its new depth of 15.5 m and will be served by the first four Liebherr ship-to-shore cranes.

Remaining berths 602 to 604, together with the Ben
Schoeman Basin, will be deepened to 15.5 m. These works will be carried out in sections throughout the five-year programme by a consortium comprising WHBO and locally based Civil and Coastal. This staggered approach will ensure that overall terminal productivity be maintained during the construction programme.

‘We are slowly but steadily transforming the container terminal into a modern four-berth facility that is able to cater for larger new-generation vessels, which require more water and upgraded quay facilities,’ says Borchards.

A major aspect of the expansion programme is the move from straddle carriers to an RTG operation. The cranes will be a huge first for the Western Cape, given that Pier 1 in Durban is the only other terminal to boast these world-class cranes. The RTG contract is due to be awarded in June 2008 and the delivery of the first RTGs is expected to commence in mid-2009.

By the end of the expansion programme in 2012, the Cape Town Container Terminal will boast no fewer than 32 RTGs with ergonomic features to enhance operators’ comfort and productivity, including an air-conditioned driver’s cabin at the top of the crane.

The cranes will span five containers and a roadway and are capable of stacking five high. They will be supplied with a GPS which will update the operating system as each container is stacked in its specific location.

A team of trainers, already trained by Sri Lankan experts at Pier 1 in Durban, will be tasked with passing on their skills and knowledge to lifting equipment operators at the Cape Town Container Terminal. Once the first RTGs arrive next year, they will be used to offer further operator training within the terminal environment.

In its entirety, the Cape Town Container Terminal expansion project includes the demolition of non-essential infrastructure and buildings and reconfiguration of the terminal to maximise stack capacity, a reefer-point expansion programme, and extension of the quayline by 10 m to accommodate the new gantry cranes.

Borchards said Transnet Port Terminals was currently diverting container vessels with their own ships’ gear to Cape Town’s Multipurpose Terminal to maintain productivity. In addition two additional berths, berth 502 and 700, are being used to cater for vessels with their own ships’ gear.

The five-year construction programme is an element of parent company Transnet Ltd’s R28 billion investment in port-related projects, from an overall R78 billion planned for investment over the next five years to decrease mounting pressure on the country’s port system.
Anglian Water’s biggest ever project

THE FINALISATION of the Wing Extension Project is Anglian Water’s biggest ever project, providing drinking water to over a million people.

One of the leading providers of water and wastewater services in the United Kingdom, Anglian Water is located in the east of England and serves the needs of around six million industrial, commercial and domestic customers.

Andrew Jordaan from Mott Macdonald Engineers became involved in the Wing Extension Project nearly two years ago. He produced the preliminary and final designs for 40 km of the new pipeline on a South African infrastructure software design package, Civil Designer.

Andrew is a South African civil engineer with extensive experience in various high-level projects. When the opportunity arose to practise these skills at the UK-based Mott MacDonald, he grabbed the opportunity with both hands and hasn’t looked back since.

The Wing Water Treatment Works extension began in 2005 when Anglian Water indicated its plans to abstract more water from Rutland Water and extend the existing water treatment works at the Wing for further water supply to the population. With the emergence of 90 000 additional homes, the project finally got off the ground.

Andrew explains: ‘Anglian Water had to extend its existing water treatment works at the Wing to provide drinking water to meet the increase in consumption. This meant that the new underground pipelines had to be laid from Rutland Water to the Wing extension and from the Wing to Kettering via Corby.’

Rutland Water was built as a reservoir in 1975 to store and provide water for treatment in the supply of domestic and commercial users. Prior to the commencement of the project, the existing pipelines and water treatment works were capable of taking up to 75 % of the amount of water that Anglian Water was permitted by license. With the proposed extensions, Anglian Water will be able to extract up to the full licensed amount from Rutland Water.

Rutland Water’s wetland area is protected by law as a special protection area. Owing to this legal environmental protection, Anglian Water is obligated to ensure that future plans for water provision incorporate the protection of special wildlife of the reservoir.

The team of designers therefore created additional lagoons and wetlands as an alternative habitat for wildlife during periods of lowered reservoir levels. They also constructed additional dams in the existing reservoirs to maintain water levels in bays during lowered levels in the main reservoirs.

The legal environmental protection on the project placed considerable limitations on the design team. Fortunately these obstacles did not present any problems while working in Civil Designer.

‘The program automatically picked up the long sections off the DTM without any user intervention. We used the aerial pictures as a background and placed the contours and cadastral plans over it to plan and plot the routes. The pipelines were laid across agricultural land and involved crossings of railways, roads and rivers.

‘The software was therefore instrumental in helping us complete the preliminary designs, feasibility studies and DTM which extended into the final design for the tunnel crossings of the major roads and railways,’ explains Andrew.

The construction of the water treatment works and the laying of the pipelines will be completed in March 2010. It will supply an average of 50 million litres per day, rising to 90 million liters per day at peak times. In addition, work for the wetlands will be completed by November 2010.

According to Andrew, the project will remain a highlight in his working career.

Pipe stringing preparation during construction
Boost for safer crane operations

IN A FASCINATING EXERCISE, containers and other cargo are being off-loaded from ships in Durban harbour using the latest cranes – without the vessels actually being in the terminal.

Using cutting-edge technology in the form of state-of-the-art computers and giant screens inside a 40 ft shipping container, a make-believe situation is created to help crane operators at Pier 1 Container Terminal in Durban practise challenging manoeuvres involving heavy and expensive cranes. The technology enables the simulation of weather conditions, environment and situations that cannot be safely replicated using traditional training methods.

South African port operator Transnet Port Terminals recently partnered with African National Engineering – the local agent for GlobalSim, a world leader in simulation training systems for the crane-and material-handling market.

The partnership has seen the introduction of the R6,7 million MasterLif 4000 advanced training simulator at Pier 1. The high-tech software and hardware system is a dual function simulator integrating two models – a Liebherr P171L ship-to-shore (STS) Crane and a Kalmar E1 rubber tired gantry (RTG) crane.

Willie Coetsee, operations training manager at Transnet Port Terminals, said the simulator was introduced to increase the safety and efficiency of critical crane operations at South African ports.

‘The MasterLif 4000 system consists of a simulated training environment for a trainee operator and a monitoring station for the facilitator and three students. Operators are able to hone their skills in order to achieve set productivity targets, without interrupting normal operations or causing millions of rands worth of damage to equipment,’ he said.

Coetsee said the system enables crane operators to carry out simulation exercises including loading and unloading a vessel under various weather conditions, stacking, de-stacking and loading containers onto private transport in the stacking yard and overcoming operational challenges like drop boxes, high wind speeds and container swaying.

Louis du Toit, business unit executive at the Transnet Academy – School of Port Operations, said the advanced system replaced the outdated crane simulator previously used at the Transnet National Ports Authority School of Port Operations.

‘We are currently training 24 RTG operators and 12 STS crane operators at Pier 1. However, the facility is mobile and will eventually be moved to Port Elizabeth where critical training will be provided to operators for work at the new Port of Ngqura,’ he said.

Ash Ramnath, systems analyst at Port Terminals, will work closely with African National Engineering to ensure the simulator will be transported safely and set up for training in Ngqura.

‘We expect that all crane operators at Transnet Port Terminals will be exposed to the simulator at some stage or another,’ said Du Toit.

Previously, RTG training was carried out at Pier 1 by Port Management Container Services or Aitken Spence, but the simulator will now enable the School of Port Operations’ own instructors to conduct the training.

Refresher training for existing operators will also be introduced at Pier 1 and the Durban Container Terminal. The actual training of a new recruit currently takes a total of twelve weeks. It is estimated that a maximum of five days on the simulator will reduce training time by at least two weeks, if not more. Actual training time will vary depending on individual ability.

Scott Huntsman, president and CEO of GlobalSim, said: ‘We see this programme as a significant step in opening up the continent of Africa to advanced training tools. Africa has many ports and they are starting to recognise major growth in shipping and construction.’

GlobalSim's simulators are found in several major ports worldwide. In the past five years, the company has delivered 86 simulators to customers at ports in Marseilles, New York, Los Angeles, Long Beach, Hamburg, Tacoma, Le Havre, Oakland and Antwerpen.

The port of Hamburg’s limited access to actual cranes for training was also remedied by GlobalSim’s MasterLif 4000 system, which has replaced 60 % of Hamburg’s need for training hours on live cranes. The port has subsequently reduced live crane training by 50 % and saved thousands of euros in fuel, maintenance and other crane-related operating costs.

Some benefits of the MasterLif 4000 system are:

■ Reduced overall training time and refresher training for veteran operators
■ Comprehensive training when live equipment is unavailable
■ Reduced costs and accidents involving novice operators on expensive equipment
■ Repetitive practice of hazardous or life-threatening scenarios that would be dangerous and impractical to practise live.
Recycling our roads

ROADS ARE EXPENSIVE and use a lot of raw materials to construct. But few people realise that our blacktops are completely recyclable – and re-using asphalt, as well as other waste materials, to build new roads will save South Africa a great deal of money and precious resources, writes Trevor Distin, CEO of the Southern African Bitumen Association (Sabita).

The accelerating depletion of the full spectrum of the earth’s natural resources – from oil to aggregates and clean air – relentlessly raises the spectre of a compromised world in which future generations are unable to match availability to necessity. This frightening prospect, which calls into question the responsibility of current political and industrial leaders towards a long-term future, has, alongside the rising awareness of climate change, given rise to a burgeoning world-wide trend towards sustainable practices in the utilisation of resources.

At an increasing rate, the same process is taking place in South Africa, and one of the leaders in this field is Sabita, which has already started establishing protocols and industry standards for recycling asphalt pavements – one of the few industrial materials that is 100% recyclable.

The motive is to ensure the perpetuation of South Africa’s hot mix asphalt and road construction industry and thus ensure the sustainability of our industry. To achieve this objective will demand that today’s leaders act today in order to ensure the availability of product for tomorrow, but there are also numerous downstream benefits. These include:

- Improved cost-effectiveness in the construction and maintenance of road networks; by incorporating reclaimed asphalt pavements (RAP) in new asphalt mixes, the road owners are using materials they already own. While RAP provides a ready source of reusable aggregate, it also provides additional bitumen binder, thus reducing the demand for non-renewable virgin raw materials. RAP replaces large amounts of virgin aggregate (which constitutes around 95% of the volume of hot mix asphalt) when used in new asphalt mixes.

- Developments in cold in-place recycling of damaged granular pavements, utilising emulsions and foamed bitumen, have encouraged the re-use of existing materials through bitumen stabilisation. At the same time cold in-place recycling will have a significant impact on reducing greenhouse gas (GHG) emissions, energy consumption and the industry’s carbon footprint.

- The versatility of hot mix asphalt fosters the use of a wide range of materials that would otherwise be classed as waste. These include steel slag, rubber from scrapped tyres which are crumbled for modification of bitumen, cellulose fibres and even glass – all of which have acceptable engineering properties appropriate to new asphalt mixes. It is important to note that these materials, including the RAP itself, remains 100% recyclable, and may be re-used again and again.

- A resource which is seldom mentioned in this scenario is the rapid depletion of landfill sites. As a primary user of thousands of tons of materials, all of which can be recycled time and again, the hot mix asphalt industry is a major contributor to the process of minimising the proliferation of landfills.

- The environmental degradation caused by gravel roads is recognised as a serious problem in South Africa, where the majority of our rural roads are unsurfaced. The demand for regular re-gravelling places immense pressure on the environment for the ongoing supply of gravel, dust from these roads has adverse effects on both roadside crops and the health and lifestyle of residents living close to passing traffic, and the heavy machine use demanded by ongoing reshaping and re-gravelling adds significantly to costly fuel usage and the emission of GHGs. All these problems could be avoided through cost-effective surfacing – which would also have the benefit of reducing road user costs and hence the price of consumer goods, and promoting cheaper mobility for rural residents.

Like Sabita, which is committed to providing an adequate and efficient transport system with minimum impact on the environment and its resources, the Aggregate and Sand Producers Association of South Africa (ASPSA) has declared its commitment to sustainability by balancing economic growth, environmental equilibrium and social performance.

In a recent publication ASPSA made it clear that effective sustainability should enjoy the total buy-in of all stakeholders (industry, authorities, labour and the community) and that these controls and regulations should be enforced to create an equitable, enabling environment for sustainability.

A major focus area for sustainability is the control of GHGs. A recent paper by the French-based Colas Group, focusing on the contribution of the road construction and transport industries to the emission of GHGs, concluded that:

- Energy consumption and GHG emissions linked to pavement construction are much less than those caused by total cumulative traffic using the road during its life (less than 1% in the case of bituminous and semi-rigid pavements carrying moderate and high levels of traffic).

- For hot mix bituminous pavements, the two main processes responsible for GHG emissions are binder and asphalt manufacture. However, in the case of reinforced concrete pavements the main processes responsible are cement and steel manufacture.

- For new pavements, the most polluting structures are reinforced concrete and the least polluting are those using bitumen emulsion technology.

- For rehabilitation, in-situ bitumen emulsion recycling is the process that consumes the least energy and contributes least to the greenhouse effect.

Sabita currently has several far-reaching initiatives under way to improve the technologies appropriate to sustainability, introduce and entrench protocols aimed at maximising resource utilisation and optimise both the reuse of existing asphalt and the introduction of products currently regarded as waste.

These projects are grounded in a commitment throughout the bituminous products industry to responsible best practice, which
demands that we ensure that bottom line profit is not pursued at the expense of existing health, safety and environmental concerns, nor of the long-term viability of the industry.

But several misconceptions about the sustainability of road pavement materials need to be cleared up to ensure that decision-makers are able to reach informed conclusions when allocating funding:

- When making a comparison between asphalt and concrete to determine their respective energy consumption and GHG emissions, life-cycle inventories covering the entire process from the manufacture of the raw component materials to the construction of the final pavement need to be carried out. Such inventories have shown clearly that asphalt pavements are more environmentally friendly than rigid pavements (concrete).

- Although the manufacture and construction of a reinforced concrete pavement is a cold process, the manufacture of cement and steel is carried out at temperatures of up to 1 600 ºC.

- Asphalt is mixed and laid at temperatures above 130 ºC, and the bitumen itself is distilled at a temperature below 375 ºC. However, bituminous materials can also be manufactured and placed at ambient temperatures by emulsifying the bitumen with chemically treated water, with significant reduction in GHG emissions.

- Additives can also be added to the bitumen during the manufacture of asphalt to reduce the mixing and paving temperatures by up to 40 ºC.

- During an analysis period of, say, 40 years, it may be true that a concrete pavement would only require limited, periodic maintenance and repair measures. An asphalt pavement, on the other hand, will normally be designed to undergo periodic rehabilitation or strengthening in the form of overlays. This staged construction, typical of asphalt pavements, is a major financial or economic advantage, for both taxpayers and investors in concessioned highways.

- Full-depth asphalt pavements, known as perpetual pavements, can be constructed (US and Europe) to ensure longer life and lower maintenance costs over the full design life of the structure.

- The perception that concrete pavements have a traffic-carrying capacity significantly in excess of that associated with asphalt pavements has not always been vindicated by experience with this type of pavement in South Africa. It is also true that high modulus asphalt technology is currently available, which elevates the traffic-carrying capacities of asphalt pavements to levels previously unattainable.

- Concrete is not economically viable as a cost-effective pavement for low trafficked roads because of its high initial cost.

- Up to 80% of Southern Africa’s flexible pavements are surfaced with a bituminous surface treatment as opposed to asphalt or concrete, due to their cost-effectiveness.

In the environment of diminishing resources and increasing costs in which the road construction sector operates, and given South Africa’s overriding need to facilitate cost-effective infrastructure provision, a duty of care must be borne by industry associations such as Sabita to ensure that decision-makers at all levels have accurate, up-to-date, and relevant information. Sabita has now undertaken to facilitate a thorough analysis of all the issues outlined above. The resulting information will be presented in an objective way and disseminated for the guidance of both government and industry—and the ultimate benefit of all road users.
SSI ENGINEERS and Environmental Consultants in joint venture (JV) with Asch Consulting Engineers have entered the construction supervision phase of a multi-million contract awarded by the South African National Roads Agency Limited (SANRAL) for the design and supervision of three hi-tech traffic control centres in Limpopo Province.

The R170 million project includes two traffic control centres – including weighbridges and holding areas – serving both directions of the Limpopo N1 and R101 and a satellite traffic control centre without a holding bay on the intersection of the N11 and R101.

The facilities use weigh-in-motion technology underneath the surface of the road to alert road officials to possible payload infringements. By weighing the force of each axle, officials can determine whether the vehicle is within statutory limits.

As a vehicle approaches the N1 and R101 traffic control centres, its registration plate is scanned and a digital image of the vehicle is captured. After driving over the weigh-in-motion sensors in a screener lane, the vehicle’s weight is captured and added to the record. If payload violation is indicated, the automated system manipulates traffic lights and booms, directing the truck to the static scale area, where it is weighed again and its registration and image are again captured and married to the existing record. If there is indeed a weight infringement, the system routes the vehicle to a holding area where its load can be repacked for better load distribution over all the axles and the vehicle released back onto the highway – or until the transport operator sends another vehicle to carry the excess goods and its payload returns to within legal limits.

If the payload is in violation of the legal limit, the vehicle will be obliged to undergo a roadworthy test to determine whether it is roadworthy in its overloaded state. Depending on the severity of the findings, the vehicle may not be allowed back onto the road until it is repaired on site or towed to a repair facility. Both the overloading and roadworthy transgressions are logged onto the system and must be corrected by the truck operator before the vehicle can be released.

The satellite traffic control centre on the N11 employs weigh-in-motion sensors to identify potentially overloaded vehicles. These vehicles are fitted with electronic tracking tags and directed to the N1 facility for static weighing.

The electronics systems were designed by specialist sub-consultants Techso and are among a new generation of hi-tech controls for traffic control centres. All incoming data is captured on a central processing system that collates information from the various sub-systems to create a comprehensive database of vehicle loading (and overloading) information. This, in turn, allows SANRAL to manage its infrastructure more efficiently.

The system will be linked to the Department of Transport’s National Traffic Information System (eNaTIS) database.
BRYAN PERRIE NEW MD OF C&CI

Bryan Perrie has been appointed managing director of the Cement & Concrete Institute (C&CI) in succession to Dr Graham Grieve, who is retiring.

Perrie (52) is regarded as one of South Africa’s top authorities on concrete pavements and is internationally held in high regard for his expertise in this field. He is the C&CI’s concrete roads project leader and was also, prior to his new appointment, technical manager of the Institute.

He obtained his BSc Eng (Civ) degree at Wits in 1977 and his MSc Eng degree from the same university in 1995. His dissertation was entitled ‘Testing of curing compounds for concrete’.

He joined the C&CI in 1984 as paving engineer after working for Murray & Roberts Road and Earthworks. Part of his duties at the C&CI subsequently included responsibility for the cement monitoring activities of the Institute. In 1994, he was appointed technical manager of the C&CI, carrying responsibility for all the technical operations.

At the beginning of 1999 – following the C&CI structural shift from a purely technical to a technical marketing organisation – Perrie was appointed roads project leader to increase the market share for concrete in road applications. He was instrumental in the establishment of the Road Pavements Forum (to which road practitioners are invited twice annually for updates on new developments) and for the development of the computer program cncPave for the design of concrete roads.

In addition to many papers and publications, Perrie is joint author of Concrete industrial floors on the ground and author of Low-volume concrete roads and Concrete intersections. He has also written sections of Fulton’s concrete technology.

BUSINESSWOMAN HONOURED

Entrepreneur Violet Mphafudi has proved that labour-enhanced road surfacing is the way to go in order to upgrade gravel roads in previously disadvantaged areas and create thousands of sustainable jobs.

Violet, who is managing director of Vioflo Services (Pty) Ltd, has been named as the recipient of the 2007 Sabita Award for Outstanding Achievement in Asphalt Technology which was conferred by the Southern African Bitumen Association (Sabita) for her sterling employment of labour-enhanced methods to upgrade some 40 km of gravel roads to a surfaced standard in the Hammanskraal and surrounding townships of the Tshwane Metro over the past nine months.

Mphafudi (44), a mother of three, commenced a three-year tender to rehabilitate and maintain roads in the Hammanskraal and Mabopane areas in May last year. By using hand-operated machinery and a surfacing methodology developed by the Johannesburg-based company Tarfix, she has been able to employ a large number of workers from these communities. So successful has she been, that her original workforce of 42 people has doubled to over 80. Women make up 40% of her staff – a fact of which she is very proud.

Sabita CEO Trevor Distin said Mphafudi and her company are a shining example of how emerging contractors can make an enormous difference in the upgrading of gravel roads to a surfaced standard by optimising the employment of labour from local communities without compromising on the cost vis-à-vis conventional mechanical methods or the quality of the finished product.

‘We hope that by recognising Violet and her endeavours we will inspire more entrepreneurs like her all over South Africa and spur all levels of government into recognising the immense value that labour-enhanced methods can play in road provision, but also in creating and sustaining a great many jobs. Every town needs a Violet, if not several Violets.’

In Violet, we have a worthy recipient of the Sabita Award. We are delighted at her success and determination, and we wish her all of the very best in every challenge she tackles in future,’ said Distin.
SEVERAL ENGINEERS HAVE had a lasting influence on the well-being of Cape Town – one thinks of Stewart, Lloyd-Davies, Shand and Morris – but few have been as influential as Sir John Coode. It was his plan for the progressive development of the Table Bay Harbour complex which eventually led to the reclamation of the foreshore and thus doubled the effective area of the CBD. Coode also made a huge contribution to the development of the harbours at East London and Durban and had a hand in the design of most other South African ports.

Coode was born in Bodmin, Cornwall, in 1816 and became a pupil of the well-known harbour engineer James Walker. At the time artificial harbours were virtually unknown, as most ports were situated in river mouths or coves. At this early stage of his career Coode attracted attention by personally developing and using diving apparatus to investigate underwater conditions for breakwater design. After qualifying he joined the practice of another famous harbour pioneer, James Rendel, and was appointed Resident Engineer for the huge Portland Harbour project south of Weymouth, Dorset, which is still one of the largest expanses of water in the world enclosed by breakwaters. When Rendel died in 1856 Coode was appointed Engineer-in-Chief, and within a few years he was recognised as the leading authority on artificial harbours. The project took 23 years to complete, after which Coode was knighted for his services.

The first president of SAICE, John Brown, served his pupillage under Coode on the Portland Harbour works but we do not know whether this connection led him to South Africa.

In the 1850s South Africa was gradually emerging from its pre-colonial backwardness. Michell (PM 2) and Montagu (PM 5) had – literally – paved the way with their roads and passes. Now, with a new representative government and a progressive governor in Sir George Grey, thoughts turned to railways and harbours.

The roadstead in Table Bay had always been treacherous; with the increase in trade, the threat of further disasters was ever prevalent. More practically perhaps, the age of steam had arrived and the Cape had become an important coaling station, but refuelling by means of jetties and lighters was slow, dirty and inefficient. Under British rule individuals and groups began campaigning for a safe and practical harbour, and eventually the authorities realised that the public had a sound case. A well-known engineer, Captain James Vetch, drew up preliminary plans, but the proposals were too expensive. Whitehall then turned to the acknowledged expert, Coode, who produced a scheme which could be implemented within an affordable annual expenditure. He conceived the idea of a breakwater into the bay from the site of the Chavonnes Battery, which would protect an inner dock and thereafter an outer basin. It was still an expensive plan for the cash-strapped colony, but the Cape politicians were ready to approve it.

Opposition came from the representatives of the Eastern Cape who, with some justification, believed that too much of the fragile colonial budget was spent on Cape Town. It was only when Grey proposed that Prince Alfred – eldest son of the Queen – should launch the scheme that Victorian and Empire loyalty overcame local prejudice, and the vote was passed.

The works for the Alfred Basin began in 1860 with due pomp and ceremony, and the first load for the breakwater was tipped by the young prince. The works were without doubt the most extensive and technically difficult ever undertaken in the colony. Blasting techniques, diving machines, cranes and steam machinery were employed for the first time, and a broad-gauge railway was laid to carry stone to the breakwater. The Robinson Dry Dock, one of the best facilities of its kind in the world at the time, was added in 1882.

Coode visited the Colony several times to check progress and to keep in touch with his Chief Resident Engineer, Thomas Andrews. Whatever the actual cost, the outcome was soon justified. After
the docks were officially opened in 1870 – again by Prince Alfred, by now Duke of Edinburgh – the wharves were soon filled with shipping, and Cape Town became a port of preference. Coode was forthwith commissioned to extend the breakwater and proceed with the larger Victoria Basin. These works took place between 1883 and 1893, by which stage Cape Town had a sizeable and viable terminal for the growing overseas trade. But Coode foresaw that more wharfage would be necessary, and he had ideas for a large basin south of his existing works. These were implemented after his death in 1892, and in time the giant Duncan Dock was built as an extension to his original concept.

Meanwhile it had become time for the Eastern Cape to get its fair share of development capital. With the improvement in local finances through the discovery of diamonds, and the consequent increase in trade, Coode was appointed in 1870 to report on all ports and harbours in the Colony. He duly planned improvements to the facilities at Port Alfred, Knysna and Mossel Bay. For Port Elizabeth he designed the north and south jetties and a retaining wall to train the Baakens River and improve scour. These were constructed between 1876 and 1881.

Anchorage in the Buffalo River at East London was hindered, in common with most South African rivers, by a sand bar across the mouth. Before Coode arrived in 1870 some work on a breakwater had been done by Woodford Pilkington, the Assistant Colonial Engineer. Coode continued with this and also built training walls along the river banks to improve the river current, which would then scour out the channel. It took twelve years to establish a navigable channel, by which time wharfs had also been built to improve landing arrangements. When Coode visited the works in 1881 the value of imports had risen from £21,000 in 1869 to £211,500. Improvements continued, but the greatest impact was made when Coode recommended that a suction dredger be acquired. The Lucy, acquired in 1886, deepened the river channel and kept the sand bar open, and proved the final factor in making East London an important port.

Durban Harbour also had difficulties with a sand bar, but here there was an additional problem – interfering politicians. The first efforts to control the sand bar were made by John Milne, a Scottish engineer who accepted the position of Harbour Master in 1852. He planned to narrow the mouth of the bay by building breakwaters from the Point and the Bluff. Work started on the North Pier, but Lieutenant-Governor Scott, who fancied himself as an engineer, decided that Milne’s scheme was flawed and dismissed him. For seventeen years Scott fiddled around with his own plans and built two useless piers, wasting some £100,000 of public money without making any improvement to the harbour. A board of enquiry was then appointed under the chairmanship of Harry Escombe, but accomplished little. But Escombe realised that a viable harbour would really put Durban on the map, and he became the champion of a drive to sort out the problems at the mouth of the bay. He went back to John Milne, now 74 years old, to help him with his vision.

At this stage, in 1871, Coode was appointed by the Colonial Office to investigate a solution. His first plan did not find favour with Milne. There was a long and bitter controversy culminating in Coode producing a second, more elaborate plan in 1877. This one was not acceptable to Escombe, who was by now a member of the Legislative Assembly and was also beginning to set himself up as a harbour design expert and coastal engineer. Coode’s plan was supported by the Colonial Office, and again there was debate, dithering and deadlock. Eventually Coode decided he had had enough, and he withdrew from the scheme.

A new engineer, Cathcart Methven, was appointed, and after further delays and interference he implemented what was in effect Coode’s scheme. After more than fifty years of controversy, Durban could at last take its place among the great ports of the world.

Coode’s colonial works were not limited to South Africa and he is acclaimed for the harbours at Melbourne, Freemantle and – what is generally considered his masterpiece – at Colombo, Ceylon (now Sri Lanka). As president of the ICE he promoted the notion that young British engineers would best gain experience by service in the colonies, and this may well have influenced a number of engineers to come to South Africa and eventually to settle here. Although he may not have been resident in South Africa, we can only agree that his impact on this country was huge and permanent.

Tony Murray
IN BRIEF

SOUTH AFRICA FACING URBAN WATER MANAGEMENT CHALLENGE

PRESSURE IS BEING PLACED on urban water management systems in South Africa as a result of the accelerated provision of housing, water and sanitation to previously unserviced sectors of the population, together with the rapid rise in urban, commercial and residential developments.

A recent project says in its report entitled Strategic guidance towards prioritising stormwater management research in human settlements that a number of projects classified as top priority are to be undertaken to deal with the growing challenge relating to stormwater management in human settlements.

The Water Research Commission (WRC) commissioned a specific needs analysis study in 2005 to identify research needs in urban stormwater drainage and sanitation. A follow-up project was commissioned in 2006 to identify additional needs and to prioritise these within the context of urban water management.

According to Jacky Burke, lead researcher on the study from SRK Consulting (SRK), the two main components of the study were an assessment of the current stormwater management situation in local government, followed by a prioritisation of future research needs that would lead to improvements. ‘Two main criteria crucial to stormwater management were identified as institutional arrangements and available resources.’

Seventeen top priority needs were recognised. A further evaluation of these needs identified seven as sector needs rather than research needs falling within the ambit of the WRC. These sector needs fall under, among others, the Department of Water Affairs and Forestry, the SA Local Government Association, the Department of Provincial and Local Government, the Institution of Municipal Engineering of Southern Africa, and the Water Information Network of South Africa.

Burke says that research has been done locally and internationally on urban stormwater in general. ‘Although the physical and chemical aspects of stormwater runoff appear to be well understood, specific knowledge of local catchments is still lacking,’ she said. ‘Extensive international experience in design methods and tools is available and this experience, particularly in the field of alternative stormwater management, needs to be adapted to South African conditions.’

Jay Bhagwan, WRC Director: Water Use and Waste Management Key Strategic Area, indicates however that the research and research capacity in this subject area has dwindled over the past years. He says the continuous change in demographics in residential settlement patterns, from high density to low density and from high income and low income, is requiring more innovative and affordable technological interventions. Many studies are now beginning to focus on the impacts of low-income, high-density urban settlements on stormwater runoff. Bhagwan also highlights the lack of attention and investment in drainage is resulting in rapid deterioration and ageing of infrastructure. Further upgrading is required to accommodate growing settlements.

Burke went on to add that approaches have now been developed to enable communities to assist in the decision-making processes that link socio-economic, environmental and technical/engineering aspects related to water and waste management issues, including stormwater.

She added, however, that while stormwater quality and the sources of pollutants have been widely researched, the component dealing with how to effectively manage these aspects for environmental and socio-economic well-being has many gaps.

Several options for treating stormwater are available, but the applicability on a wide scale in South Africa has not yet been assessed adequately. So far, the focus in South Africa on re-use of stormwater has largely been on re-use in industry and the mining sector and via infiltration to groundwater. However, alternative re-use options used internationally may provide sustainable solutions to stormwater management in South Africa.

COURT RULING ON WATER SETS ‘GLOBAL PRECEDENT’

A LANDMARK HIGH COURT RULING against a multimillion-dollar prepaid water scheme in South Africa’s largest township, Soweto, has been heralded as a global precedent in the struggle for the basic human right to water. The City of Johannesburg is expected to appeal the judgment and residents realise that ‘the struggle will not end anytime soon’, reports IRIN, the humanitarian news and analysis service of the UN Office for the Coordination of Humanitarian Affairs.

‘Water is life, sanitation is dignity – this case is about the fundamental right to have access to sufficient water and the right to human dignity,’ said Judge Moroka Tsoka in the Johannesburg High Court.

In a class-action suit, five residents of Phiri, one of Soweto’s poorest townships, asked the court to order the city to provide at least 50 litres of free water per person per day, double what they currently receive but the basic minimum prescribed by the World Health Organisation.

They also asked that they be given the choice of an ordinary credit water meter instead of the prepaid system imposed by the city, on which the court ruled in their favour as well.

‘The case is the first in which a South African court has come out in favour of the poor. It sets a global precedent; it shows the defects of prepaid water meters, which require people to pay in advance, which discriminates against the poor,’ Asifg Khalfan, Coordinator of the Right to Water Programme of the Centre on Housing Rights and Evictions (CHORE), told IRIN.

CHORE, a Geneva-based non-governmental organisation (NGO) that campaigns for the protection of housing rights, had joined the High Court proceedings as a ‘friend of the court’, which allows an independent party to introduce useful information relating to the case, with the permission of the court.

The UN suggests that in most cases 50 litres of water a day is insufficient. During his submissions in December 2007, Wim Trengove, advocate for the Phiri residents, said international research showed that across the globe in areas comparable to South Africa between 150 and 400 litres a day per person was the norm.

‘This decision will be an immense boost to poor communities in South Africa and elsewhere. It is a warning shot against attempts to forcibly impose prepaid water systems on the poor elsewhere in Africa and globally,’ Khalfan said.

‘The judgment incorporates the best of South African jurisprudence, international law and comparative jurisprudence, a CHORE statement said. ‘It creates a useful precedent for litigation globally.’
When the prepaid meters, deemed 'unconstitutional and unlawful' by the court, automatically disconnect the water supply once a household has used up the 6,000 free litres given by the city, the connection remains severed unless the user can afford to top up. ‘To expect the applicants to restrict their water usage, to compromise their health by limiting the number of toilet flushes in order to save water, is to deny them the rights to health and to lead a dignified lifestyle,’ Judge Tsoka ruled.

Tsoka argued that it contravened the ‘right to equality’ if some Johannesburg residents – those with regular meters – got access to credit, while those in other areas – such as the residents of Soweto with prepaid systems – were denied the same privilege.

‘The underlying basis for the introduction of prepayment meters seems to me to be credit control. If this is true, I am unable to understand why this credit control measure is only suitable in the historically poor black areas and not the historically rich white areas. Bad payers cannot be described in terms of colour or geographical area,’ he maintained.

**Underlying problem not solved**

Virgil James, spokesman for the City of Johannesburg, said ‘the implication [of the ruling] is huge’.

The prepaid system was part of a larger scheme called operation Gcin’amanzi, meaning ‘save water’, to improve and expand Soweto’s ageing waterworks. ‘The idea is to save water – there have been huge water problems over the years. It’s about upgrading the whole system in Soweto,’ James told IRIN.

‘The problem for the city had been the large amount water that was unaccounted for,’ he said. Estimates on the City of Johannesburg’s website put water loss in the township alone at about seven billion litres a month. ‘The meters have already led to a significant reduction in unaccounted water loss, saving money.’

James said the prepaid system had been put into operation because it ‘would allow residents to control their consumption’ and thus benefit the poor, as water would cost them nothing if they used only the free allocation. With more than 78,000 meters installed to date, the new system had thus far saved 52 billion litres of water.

According to the City of Johannesburg website, households used 66,000 litres per month in 2003. This had dropped by a staggering 81% per user to 12,000 litres per month in 2007.

James said the prepaid meters ‘should not be seen as a punitive measure; residents in other areas also pay for use with conventional meters. If they don’t pay, they also get cut off.’

He remarked that ‘there is a culture of non-payment throughout the whole city. Water in Soweto had never been metered before in the first place, so conventional water meters would not work there – people would just not pay for consumption.’

Soweto residents used to receive unlimited water for a flat fee of R149 (about US$20) but payment levels were always low due to
the long-standing practice of boycotting services payments, which was used as a method of opposition to the apartheid government in the 1980s.

Free water was not sustainable, James argued, because the city was also under pressure to collect money to be able to provide services. ‘We don’t get it for free [from our supplier],’ he pointed out.

Nevertheless, a way should be found to subsidise the poorest of the poor, but the money will still have to come from somewhere – now, even those that don’t need it, that can afford it, are getting water for free,’ he said.

But the court said there was no need for the water utility to recoup investments, and insisted that Johannesburg City had both the financial means and access to sufficient water to provide 50 litres per person per day.

Not over yet

Patra Sindane, spokesman for the Coalition Against Water Privatisation, told IRIN that residents of Phiri ‘were already removing [the prepaid meters] and bypassing them’.

The challenge now is to make sure that Joburg water respects the judge’s order,’ Sindane commented. ‘The struggle will not end anytime soon.’

James pointed out that the judge had not said residents could go ahead and remove the meters. ‘This will lead to more huge water loss and high repair costs. This is not going to end now,’ he warned.

‘A ruling has been made and City of Johannesburg has to respect the ruling. We are now analysing the ruling in depth in order to be able to make an informed decision as to whether we want to appeal or not.’

The water distribution system is to be completed by August 2008 and irrigation should commence in October 2008.

The project team consists of three teams, the client, consulting engineers and various contractors. The client’s team is made of the SWADE CEO, project director, engineering manager and the ADEMU manager (Agricultural Development and Environmental Management Unit). The consultant’s team is made of the team leader, two senior resident engineers and resident engineers for the four different sections works. The contractor at the weir and sand trap is Group Fice, CMC is constructing the feeder canal and main canal south, and a joint venture between Concor, Group Five and Inyatsi Construction is constructing the dams.

E1,6 BILLION WELL SPENT ON LUSIP DAMS, SWAZILAND

THE LOWER USUTHU SMALLHOLDER IRRIGATION PROJECT (LUSIP) is a poverty-alleviation project by the government of Swaziland that is managed by Swaziland Water and Agricultural Development Enterprise, SWADE, a parastatal of the Ministry of Natural Resources.

The project involves the construction of three dams, namely Mhlathuzane Golome and Saddle dam, weir and sand trap, feeder canal and the main canal south. The dams will feed from the Usuthu River, water being diverted from the wet season flood flows.

The project is divided in to two phases; phase 1 being the construction of the dams and a distribution system to irrigate close to 6 500 ha of irrigable land. The second phase consists of construction a water distribution system of approximately 5 000 ha.

The aim of the project is to reduce poverty and improve the standard of living for 15 000 people in the Lower Usuthu basin, in south-east Swaziland. Most are subsistence farmers who live in the lowveld under sometimes quite difficult conditions. The project will achieve this through commercialising and intensification of agriculture by integrating smallholder household farmers into the commercial economy through the provision of irrigation infrastructure and by sustainable improvement in environmental health.

The project is divided mainly into four sections: the weir and sand trap, the feeder canal, the three dams and the main canal south. The three dams consists of 1 250 000 m³ bulk excavations, 35 000 m³ of conventional concrete and 560 000 t of crushed products, 400 000 m³ of rockfill and 420 000 m³ of clay core and filters.

Mhlathuzane Dam is constructed from roller compacted concrete (RCC) 50 m high, 300 m long, 135 000 m³ of RCC, Golome Dam a clay core/rockfill dam, 50 m high, 650 m long, Saddle Dam a homogeneous fill dam, 10 m high, 900 m long and a spillway constructed from conventional vibrated concrete (CVC) with an ogee type overflow structure.

The project is currently in the completion stage of the major infrastructure. Water has been impounded in the reservoir and shortly will be commissioning the weir and feeder canal. The first phase of the water distribution system has been awarded and to Inyatsi construction and construction is soon to begin.

WATER AWARDS PRESENTED

THE INAUGURAL WATER CONSERVATION and Water Demand Management Awards were presented by Mrs L B Hendriks, the Minister of Water Affairs and Forestry (DWAF), at a function at Gallagher Estate in Midrand.

In her address, the Minister said that these awards are an important part of efforts to prevent water waste and that they will help establish a new culture of water conservation.

Merwe du Preez, chairman of the Gamtoos Irrigation Board (winner in the Irrigation Sector), Minister of Water Affairs and Forestry Lindiwe Hendriks, and Pierre Joubert, CEO of the Gamtoos Irrigation Board
create a culture of water conservation amongst South Africans by recognising excellence in the implementation of water conservation and water demand management programmes. She added that in a water-scarce country with a growing economy, the challenge is how to go beyond the provision of access to water and sanitation services and also ensure the continued availability well into the future.

A recent Water Research Commission project estimated that revenue not earned by municipalities as a result of water losses is in excess of R3.2 billion per annum. Through DWAF’s water conservation pilot programme water and revenue losses are being addressed by municipalities as a result of water losses is estimated that revenue not earned by municipalities already saving in excess of 40% of their total raw water bill.

EUROPEAN COMMISSION SHORTLISTS DUTCH WATER INNOVATION

ENGINEERING CONSULTANCY DHV has been shortlisted by the European Commission for a 2008 European Business Award for the Environment (EBAE).

The jury selected DHV in the ‘eco-innovative processes’ category on the basis of the company’s environmentally friendly Nereda water treatment technology. Nereda is the latest innovative technology for the treatment of wastewater developed by DHV and Delft University of Technology.

It makes use of bacteria which do not grow in floc form, as is normally the case, but rather as concentrated and compact granules. These granules sink much faster than flocs, whereby the entire treatment system requires less space and has lower construction costs. The Nereda technology is financially attractive due to its lower investment cost and lower energy consumption. The technology can be used for treating both municipal and industrial wastewater. Nereda is already operational in the Netherlands, and Nereda treatment plants are currently under construction in South Africa and Portugal.

According to Stavros Dimas, European Commissioner for the Environment, the EBAE winners are ‘the best of the best: the most far-sighted, responsible and innovative companies in Europe’.

Every two years, the European Commission honours those European companies that distinguish themselves with products or services that are innovative, cost effective and protect the environment.

BIOLOGIST IS WORKING TO LIMIT IMPACT OF HYDROELECTRIC DAMS IN ASIA

RIVERS AROUND THE WORLD are being tamed by massive hydroelectric dams, with high-profile projects under construction in Laos and China and several proposed for the Mekong River in Southeast Asia. Researcher Guy Lanza of the University of Massachusetts Amherst is working to limit the environmental impact of these projects, which he says often deliver a legacy of economic hardship and health problems instead of prosperity for people living near the dams and downstream.

‘After dam construction, there is an immediate drop in water quality that destroys useful fish populations and poses a threat to livestock and humans,’ says Lanza, an aquatic biologist and microbiologist who consults for the environmental organization International Rivers. ‘Converting river systems into lakes also creates more habitat for the snails and mosquitoes that carry malaria, dengue fever and schistosomiasis, leading to an increase in the number of cases of these diseases.’

Lanza recently critiqued the Nam Theun 2 Hydroelectric Project, a 1 200 foot wide expanse across the Nam Theun River in Laos that will be completed in December 2009. Dam gate closure and reservoir filling were due to begin in June 2008, and power from the dam will be exported to Thailand as part of the Laotian government’s plan to generate export revenue by building more than 30 dams by 2020.

After reviewing the NT2 environmental assessment and management plan, Lanza worked with International Rivers, and together their efforts helped to convince the Nam Theun 2 Power Company to remove some of the biomass, in the form of fallen trees and leaves, before filling the reservoir instead of simply leaving it behind to rot. The experience with Nam Theun 2 has highlighted the importance of clearing biomass from future dam projects, a requirement the Laotian government is reportedly considering.

Lanza says, however, that the Nam Theun 2 biomass clearance plans, which include cutting and burning biomass from part of the reservoir area, may not prevent significant water-quality problems. ‘Burning biomass adds air pollutants, including carbon dioxide, ozone and other greenhouse gasses, and toxic substances such as mercury,’ he says. ‘Burning will also release mercury to the soil and greatly accelerate the release of nutrients such as nitrogen and phosphorus from the biomass.’

After burning, nutrients from the ash would trigger and support the sudden growth of excess bacteria and algae in the water as the reservoir fills, triggering a cascade of water-quality problems, including greatly reduced dissolved oxygen, fish kills, the formation of toxic metabolites by cyanobacteria, and the release of toxic gasses and metals such as...
hydrogen sulfide and mercury from reservoir sediments.

Leaving the biomass behind would also be problematic, says Lanza, since rotting vegetation would increase greenhouse gas emissions from the reservoir, use the available oxygen in the water, cause fish kills and result in water that was unsuitable for drinking and irrigation.

In 1996, Lanza reviewed the environmental impact report for the Nam Leuk Hydropower Project in Laos and visited the site after the dam was complete, which reinforced his concerns and confirmed his predictions.

‘After the completion of Nam Leuk, there was a sharp drop in the oxygen content of water in the lake and blooms of cyanobacteria that release toxins that are deadly to livestock and can cause liver cancer in humans,’ says Lanza. ‘The data show that water-quality problems eliminated useful species of fish that people depend on for food and livelihood, replacing them with less desirable species.’

Villagers downstream of the project were experiencing water-quality problems, and the Nam Leuk reservoir provided expanded habitats for the snails and mosquitoes that carry schistosomiasis and malaria, threatening a rise in the number of cases of these diseases.

‘Midstream dams are again being proposed for the Mekong River, and we are finding that disease-causing schistosomes are much more prevalent in this area than we originally thought. This must be considered when developing future environmental assessment and management plans,’ says Lanza.

TOP SOLUTION FOR WASTEWATER PUMPING

THE COST OF INSTALLING wastewater pumping solutions can be time consuming and prohibitive as an extensive civil infrastructure is required.

Not so, says Mark Hultzer, business unit manager – public utilities at ITT Water & Wastewater, who claims that the company has developed a turnkey wastewater pump station solution which once installed will eliminate the majority of problems currently being experienced at local facilities. These include crust build-up, floaters and sedimentation. In all three cases the ultimate result is unpleasant odour emission and pump blockages.

Known as TOP, the system’s modular, flexible design comes in a range of sizes to suit depths between 1.5 m and 6 m and capacities between 4 ℓ and 95 ℓ per second.

‘Our engineers take full responsibility for dimensioning a customer’s pump station and completing the order, which reduces costs for project planning and installation,’ Hultzer says.

‘ITT Water & Wastewater’s philosophy has always been to make equipment that maximises lifecycle economy, which means designing for long service life and minimum downtime,’ he continues. ‘And this is exactly the design criteria behind the successful TOP pump station.’

Retrofitting and upgrading

The TOP turnkey concept is the ideal solution for refurbishing old pump stations. ITT Water & Wastewater engineers can retrofit old stations with a TOP solution delivered as a kit, which is
then installed in the existing structure with a minimum of construction work and no added excavation needed.

Retrofitting a TOP station can help to significantly reduce the costs of service call-outs and maintenance and to achieve operating cost reductions. Larger models (with discharge diameters of 65 mm to 150 mm) are fitted with a MULTI/JOINT, which takes a wide range of external pipe diameters and piping materials: stainless steel, cast iron, carbon steel, glass fibre and PE.

The discharge connection also allows an angular deviation of ±7°, so the pipe end can be simply inserted into it and tightened. With no welding or drilling required, there is a significant saving in installation time.

Customers already operating installations with old wastewater pumps can extend the service life of equipment and benefit from superior pumping efficiencies by using the Flygt N pump upgrade kit.

The ITT Water & Wastewater TOP system is suitable for wastewater, transfer stations and other chemical pumping stations.

CLASS OF ‘58

CIVIL ENGINEERING GRADUATES of the 1958 class gathered at the University of Cape Town on 4 April to celebrate their 50th reunion. Twenty-nine of the original 58 students – from as far afield as Australia, Canada, the US, Zimbabwe and, of course, South Africa – were joined by two of their lecturers, Professor Mike de Kock and Tony Kilner, to relive their happy days at the university. The gathering was organised by classmate Ron Strybis. Some of the graduates had not seen each other since the day they graduated in 1958 so there was lots of catching up to do.

At the last minute there was a scramble to change the programme to fit into Eksom’s ‘scheduled power shedding’. The reunion included fascinating talks given by six of the alumni on topics which ranged from ‘Emperor Bokassa – madman for a client’ and a slide show of Colorado to ‘Kite surfing – a retirement option’. They were then taken on a tour of the research laboratories where they met various academics and students who spoke to them about the research happening in the department.

The rest of the weekend was spent having dinner at Kelvin Grove, going up Table Mountain (kindly sponsored by one of the alumni; visiting the 2010 FIFA World Cup stadium currently being built in Green Point, and lunching at Bing Walker’s home in Llandudno.

They all said they had a wonderful time and were impressed by the university and all the new developments happening in the faculty. When asked what made this class so special that there was such a good turnout after 50 years – they all replied: Bing Walker – he was the greatest cheer leader for six years!

They have all diarised their 60th reunion, which will be taking place in 2018!

BUSINESS ON THE MOVE

BELIEVED TO BE THE FIRST of its kind in the country, a new virtual office park has been established in the centre of the Maputo Development Corridor (MDC). For any business or entrepreneur needing temporary – yet fixed – office space, Central Park in Nelspruit has the solution for commuters, sales executives and small, medium or start-up businesses.

Obviating the need to sign long leases, Central Park has fully equipped, serviced offices available for a few hours, a few days, a regular weekly or monthly slot, or whatever is needed. This flexible arrangement doesn’t cost much either: at only R200 per day, Central Park is affordable for all types of business.

Customers can rent a desk, boardroom or conference room; they will have broadband access to the internet (the first 5 MB of usage is free), telephones, printers, stationery and reception services as well as a fully equipped mini conference room that seats 40+ people.

Comprising rail, road, port and terminal facilities, the Maputo Development Corridor is seeing billions of rands being spent on projects to help release potential in the landlocked regions of Mpumalanga, Gauteng and Limpopo. The Department of Trade and Industry has identified that tourism, manufacturing and agriculture will be the primary industries. Central Park developers J D & Associates anticipate an increasing demand for temporary office space as deals are struck in the region.

John Powell of J D & Associates says that not all of the businesses linked to the MDC will want to establish permanent office space, particularly as they may only need to be in the

Some of the graduates in the Water Research Lab in the Department of Civil Engineering: Bob Blyth, Jannie de Villiers, Neil Grant, Bing Walker and Eric Burnett
area for a few weeks. ‘Commuting has never been made so easy or so efficient!’

**First World in the bush**

Business in the bush takes on new meaning at Central Park. As a light industrial and commercial high-tech business park, Central Park has appeal for businesses that want good network links, a beautiful environment and First World facilities. ‘Nelspruit is fast emerging as a major international hub,’ adds Powell.

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**ANOTHER RECORD YEAR FOR CEMENT PRODUCTS SALES**

A RECORD TOTAL of 15,3 million tonnes of cementitious products were sold in the southern African region in 2007 – a 7,4% growth on the previous year, according to the Cement & Concrete Institute’s 2007 Cement & Concrete Review.

John Sheath, marketing manager of C&CI and author of the annual review, however notes that this total included 1,6 million tonnes of fly ash and slagment used for extending or enhancing concrete mixes and that this total should therefore not be included in cement demand or capacity comparisons.

Sales to neighbouring countries were 18,5% up on 2006 with particularly strong demand from Botswana (up 33%) and Namibia (up 12%).

Domestically, cement sales to the nine South African provinces were 6,6% higher with positive growth shown in all the provinces, except for the Western Cape, which showed a 1,7% decline in cement demand. The Eastern Cape and Northern Cape showed the greatest increase in sales (12%), with Gauteng demand up by 10% last year.

Sheath reports that cement sales to civil engineering contractors – in line with the exceptional growth in this industry sector – increased by 23,5% in 2007. ‘Sales to blenders of cementitious products were also very high, reaching the 1 million tonne level for the first time, and showing an increase of nearly 25% over 2006,’ he states.

‘Last year was also a remarkably good year in terms of the volume of residential building activity, but much of this had to do with a mini-surge in demand that overflowed from 2006, thanks largely to transfer duty and personal tax relief. The non-residential market maintained good growth, although slower economic growth and infrastructure bottlenecks will inevitably impact investment in this category,’ he adds.

Looking to the future, Sheath says although the economy had experienced setbacks since the beginning of 2008, the more positive news is the government’s commitment to infrastructural spending which should support construction growth in the short and long term.

‘The longer-term view on the residential property market remains depressed as high interest rates and continued pressure on building cost inflation negatively affect affordability. However, the low-cost and affordable housing sector could well boom with R39 billion of the government’s infrastructure budget allocated to this sector.’

He comments that the medium-term outlook for retail space is less favourable and
that the development of industrial space has also slowed down. However, with the civil engineering sector expected to continue its unprecedented growth this year, industry forecasts for cementitious demand in 2008 are still positive, although generally reflecting the slower growth experienced in the residential sector.

**UPGRADING OF KNYSNA ROAD AND ASSOCIATED INTERSECTIONS**

Owing to the high economic growth rate and development experienced in George over the past few years, namely the Garden Route Mall, the Kraaibosch Residential Estate and the Blue Mountain Village, the project of upgrading the Knysna Road and Kraaibosch surrounding areas was undertaken by the George office of consulting engineers Vela VKE.

The purpose for the upgrading of this road was:
- Ensure easy access to developments
- Minimise congestion and ensure high mobility and traffic flow
- Accommodate public transport
- Integrate non-motorised transport facilities
- Ensure adequate access to adjacent developments and road networks
- Set the standard for future road construction in the Kraaibosch area

Public transport is seen as an integral part of the development of the Kraaibosch road network. The development of some 2,400 residential units will create many job opportunities, not only during the construction but also in the long term.

Problems encountered during construction included:
- High traffic volumes and speeding vehicles
- Existing service relocations
- Inclement weather
- Unsuitable in-situ soil conditions below the roadbed. Material had to be removed to a depth of up to 800 mm below the roadbed and replaced with suitable road building material from commercial sources.

**PDNA COMMENDED IN TOP 500 LISTING**

P.D. Naidoo & Associates (PDNA), one of the largest historically disadvantaged engineering practices in South Africa, has been named as a highly commended company within the Top 500: South Africa’s Best Companies’ Consulting Engineers: Mining and Infrastructure Sector.

Top 500 is an annual B2B publication that identifies companies achieving the highest level of performance and success by researching the performance information of thousands of organisations annually, assessing these companies within their industry sectors, and finally by compiling a list of the top 500 performing firms over 100 sectors.

Companies are reviewed against a 13-point set of criteria. Corporate performance is measured against turnover, growth (%), growth (rands), CSI expenditure, turnover per employee, the percentage of female and black employees, the percentage of black directors (executive and non-executive), the percentage of female directors (executive and non-executive), company policies (written) and company accreditations.

Says Dempsey Naidoo, PDNA executive chairman: ‘The fact that PDNA was named as a Top 500 Highly Commended Company within the Consulting Engineers: Mining and Infrastructure Sector is a fantastic achievement. However, we shall not be resting on our laurels and will use this success as encouragement to do even better next year.’

**CONCRETE PAVEMENT TESTING PAPER WINS SAICE AWARD**

The New Cement & Concrete Institute MD, Bryan Ferrie, and fellow authors Pieter Strauss, Louw du Plessis and Dennis Rossmann were recently honoured with the South African Institution of Civil Engineers (SAICE) Transportation Engineering Division award for the Best Paper in 2007.

The paper, entitled ‘Accelerated pavement testing of load transfer through aggregate interlock and the influence of crack width and aggregate type – a case study’, was presented at the International Workshop on Best Practices for Concrete Pavements, in Recife, Brazil, in October 2007.

Another paper, ‘Ultra thin continuously reinforced concrete pavement research in SA’,
GLOBAL AWARD BY PUBLIC PRIVATE PARTNERSHIP INDUSTRY

HAVING WON A COVETED AWARD as the Best Global Project to Sign, Gautrain earned the respect of the international public private partnership (PPP) industry at the tenth annual Public Private Finance Awards evening held on 29 April in London.

The awards are the biggest event in the PPP industry, attended by over 1,400 people last year. The winners are picked by an independent panel of partnership experts to highlight the best deals and companies in the market. The competition is held by the Public Private Finance magazine, a respected publication about PPP projects in the United Kingdom and Europe.

As one of 22 category winners, judges recognised Gautrain’s expertise to overcome the unique engineering and socio-economic developmental requirements of this PPP project. Geological difficulties, the intricate topography of Gauteng and the unique socio-economic deliverables of Gautrain Project made it a deserving winner. Other PPP projects shortlisted in the Best Global Project to Sign category were Britannia Mine Water Treatment Plant and the Conference Centre Dublin.

‘This award shows we can hold our own in the world,’ says Jack van der Merwe, CEO of the Gautrain Management Agency and Gautrain Project Leader. ‘It is attributed to hard-working South Africans like Metja Ledwaba from Ledwaba Mazwai that was responsible for the legal aspects of putting the Gautrain deal together. This was done in association with international legal consultants Pinsent Masons,’ says Van der Merwe.

Jerome Govender, CEO of the Bombela Concession Company which holds the 20-year concession to design, build, part-finance, operate, and maintain Gautrain, said: ‘This confirms our belief that Gautrain is truly a world-class South African project. Along with the Gauteng Provincial Government, Bombela’s sponsor companies, Murray & Roberts, Strategic Partners Group, Bouygues, and Bombardier have been integral in reaching signature of financial close last year.’

As a Gauteng Provincial Government initiative, Gautrain is recognised as the biggest PPP project in Africa. Gautrain’s private partners are structured under the Bombela Concession Company.

NANOWIRES MAY BOOST SOLAR CELL EFFICIENCY

UNIVERSITY OF CALIFORNIA, San Diego electrical engineers have created experimental solar cells spiked with nanowires that could lead to highly efficient thin-film solar cells of the future.

Indium phosphide (InP) nanowires can serve as electron superhighways that carry electrons kicked loose by photons of light directly to the device’s electron-attracting electrode – and this scenario could boost thin-film solar cell efficiency, according to research recently published in NanoLetters.
The new design increases the number of electrons that make it from the light-absorbing polymer to an electrode. By reducing electron-hole recombination, the UC San Diego engineers have demonstrated a way to increase the efficiency with which sunlight can be converted to electricity in thin-film photovoltaics.

Including nanowires in the experimental solar cell increased the ‘forward bias current’ – which is a measure of electrical current – by six to seven orders of magnitude as compared to their polymer-only control device, the engineers say.

‘By growing nanowires directly on an untreated electrode surface, you can start thinking about incorporating millions or billions of nanowires in a single device. I think this is where the field is eventually going to end up,’ said Novotny. ‘But I think we are at least a decade away from this becoming a mainstream technology.’

Polymer solar cells and nanowires meet

As in more traditional organic polymer thin-film solar cells, the polymer material in the experimental system absorbs photons of light. To convert this energy to electricity, each photon-absorbing electron must split apart from its hole companion at the interface of the polymer and the nanowire – a region known as the p-n junction.

‘In effect, we used nanowires to extend an electrode into the polymer material,’ said co-author Edward Yu, a professor of electrical engineering at UCSD’s Jacobs School of Engineering. ‘We contributed one approach to growing nanowires directly on metal.’

The UCSD electrical engineers grew their InP nanowires on the metal electrode – indium tin oxide (ITO) – and then covered the nanowire-electrode platform in the organic polymer, P3HT, also known as poly(3-hexylthiophene). The researchers say they were the first group to publish work demonstrating growth of nanowires directly on metal electrodes without using specially prepared substrates such as gold nanodrops.

‘Just a layer of metal can work. In this paper we used ITO, but you can use other metals, including aluminium,’ said Paul Yu.

Growing nanowires directly on untreated electrodes is an important step toward the goal of growing nanowires on cheap metal substrates that could serve as foundations for next-generation photovoltaics that conform to the curved surfaces like rooftops, cars or other supporting structures, the engineers say.

‘Having a more efficient method for getting electrons to their electrode means that researchers can make thin-film polymer solar cells that are a little bit thicker, and this could increase the amount of sunlight that the devices absorb.

The online journal *NanoLetters* published this new work on polymer/nanowire hybrid photovoltaics in February 2008.

‘If you provide electrons with a defined pathway to the electrode, you can reduce some of the inefficiencies that currently plague thin-film solar cells made from polymer mixtures. More efficient transport of electrons and holes – collectively known as carriers – is critical for creating more efficient solar cells,’ said Clint Novotny, the first author of the *NanoLetters* paper and a recent electrical engineering PhD from UC San Diego’s Jacobs School of Engineering. Novotny is now working on solar technologies at BAE Systems.

Simplified nanowire growth

The engineers devised a way to grow nanowires directly on the electrode. This advance allowed them to create the electron superhighways that deliver electrons from the polymer-nanowire interface directly to an electrode.

‘If nanowires are going to be used massively in photovoltaic devices, then the growth mechanism of nanowires on arbitrary metallic surfaces is an issue of great importance,’ said co-author Paul Yu, a professor of electrical engineering at UC San Diego’s Jacobs School of Engineering. ‘We contributed one approach to growing nanowires directly on metal.’

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‘In effect, we used nanowires to extend an electrode into the polymer material,’ said co-author Edward Yu, a professor of electrical engineering at UCSD’s Jacobs School of Engineering.

While the electrons travel down the nanowires in one direction, the holes travel along the nanowires in the opposite direction – until the nanowire dead ends. At this point, the holes are forced to travel through a thin polymer layer before reaching their electrode.

Today’s thin-film polymer photovoltaics do not provide freed electrons with a direct path from the p-n junction to the electrode – a situation which increases recombination between holes and electrons and reduces efficiency in converting sunlight to electricity. In many of today’s polymer photovoltaics, interfaces between two different polymers serve as the p-n junction. Some experimental photovoltaic designs do include nanowires or carbon nanotubes, but these wires and tubes are not electrically connected to an electrode. Thus, they do not minimise electron-hole recombination by providing electrons with a direct path from the p-n junction to the electrode the way the new UCSD design does.

Before these kinds of electron superhighways can be incorporated into photovoltaic devices, a series of technical hurdles must be addressed – including the issue of polymer degradation. ‘The polymers degrade quickly when exposed to air. Researchers around the world are working to improve the properties of organic polymers,’ said Paul Yu.

As it was a proof-of-concept project, the UCSD engineers did not measure how efficiently the device converted sunlight to electricity. This explains, in part, why the authors refer to the device in their *NanoLetters* paper as a ‘photodiode’ rather than a ‘photovoltaic’.

Having a more efficient method for getting electrons to their electrode means that researchers can make thin-film polymer solar cells that are a little bit thicker, and this could increase the amount of sunlight that the devices absorb.

**FIRE DOOR ORDERS SECURED FOR TWO 2010 STADIA**

BITCON INDUSTRIES, a leading supplier of fire doors, has secured contracts for its products for two of the 2010 FIFA World Cup stadia currently under construction.

Bob Vollmer, director of Bitcon, says the company is supplying the fire door requirements for both the Mbombela Stadium in Nelspruit and the Moses Mabhida Stadium in Durban. ‘The Mbombela Stadium order is for hinged fire doors and also transformer room doors, and Bitcon is supplying hinged fire doors for the Moses Mabhida Stadium.’

Bitcon’s Rubidor fire doors are clad with a variety of finishes including masonite, timber veneers, Formica laminates, and edged with hardwood lipping. Double doors are fitted with rebated stainless steel meeting stiles.

The door frames are pressed from either 1,6 mm (Class A & B) or 2 mm (Class D) steel sheet, or from galvanised sheet if required. Heavy-duty flanged brass hinges with nylon washers are fitted to the doors and viewing panels can be included where permitted.

Bitcon transformer room doors are designed for durability and security. The doors are supplied with special pressed metal frames in a double rebated profile. Fitted with heavy-duty hinges, the doors also feature pull handles, pad latch and barrel bolts. Louvre vents and panels can be fitted for air flow and ventilation.

A subsidiary of Vitrex, Bitcon operates from

———

**NEWSWISE**
a high-technology manufacturing plant in Jet Park where its respected Rubidor fire doors are produced to meet the requirements of the national test standard, SANS 1253:2003. Bitcon recently completed an expansion programme to boost manufacturing capacity and stockholding.

INFO

Bob Vollmer
Bitcon Industries
T 011-826-6057

UMHLANGA’S RIDGESIDE DEVELOPMENT

BOSCH PROJECTS, part of Tongaat Hulett Development’s professional team, has completed the preliminary design of the electrical reticulation network as well as the street and urban lighting system for Umhlanga’s proposed Ridgeside development.

‘The 140 ha site, which will be developed in four phases over the next decade, will link Umhlanga Ridge to the sea, via a unique coastal setting with maximised sea and forest views,’ says Derick Serfontein, a director of Bosch Projects, part of the B & A Group. ‘This prestigious development will include mixed use business and residential components, where buildings, parks and piazzas will be terraced to minimise the steep slope of the land. Basement parking will enhance open public spaces.’

Forty hectares of the site will be green
space with water features and pond systems
and there will be cycle and walking paths
which will be illuminated and monitored via
CCTV.

The mixed-use precinct will include
150 000 m² of offices, residential property
and the R1,3-billion Marriott Hotel. The office park
precinct will include 100 000 m² of prime office
accommodation.

The lighting system for the proposed
pedestrian and vehicular bridge will also be
designed by the Tongaat Hulett Developments
team.

GOLDER ASSOCIATES AFRICA
OPENS MOZAMBIQUE OFFICE

FOLLOWING CLOSELY on the establishment
of an office in Ghana, which will serve West
Africa, Golder Associates has opened Golder
Associados Moçambique Limitada (GAML)
its Maputo-based Mozambique office, on 16
April 2008. The office will serve the mining, oil
and gas industries in that country and forms
part of a proactive expansion strategy into the
continent that will enable Golder Associates to
better serve its clients in Africa.

says Frank Wimberley, regional manager:
‘Mozambique is southern Africa’s fastest-
growing economy after Angola. It is expected
to grow 8 % this year and the country has
recently benefited from debt relief and rising
investment in large projects such as the Moza
aluminium smelter.

‘The Mozambique government is also en-
couraging large infrastructure investments as
a means to stimulate growth. Any large-scale
infrastructure investment offers many oppor-
tunities for Golder Associates to be the con-
sultant of choice by offering our full spectrum
of products and services, while contributing to
sustainable development.’

The newly opened Maputo office already
has an established client base including Rio
Doce Mozambique (RDMZ), owned by the
Brazilian mining and metals company, Vale.
RDMZ owns the Moatize Coal Mine in Tete,
Mozambique, which consists of five open-cast
pits for which Golder Associates has already
completed three large projects worth more than
US$3 million.

In addition, Golder Associates
Mozambique has environmental and infra-
structure projects under way with:
- Riversdale Mining Limited – which has
large coal projects in the Tete region,
Mozambique
- Mittal Steel South Africa – Africa’s largest
steel manufacturer, which owns two steel
mills in Mozambique
- BHP Billiton – the diversified resources com-
pany, which is involved in a mineral sands
project in Mozambique’s Gaza Province
Current projects for which the Mozambique
office will take responsibility amount to more
than US$3.5 million and include environmental
impact studies and infrastructure develop-
ment work. A further six proposed projects are
in the pipeline.

Says Wimberley: ‘We have established
an alliance with the environmental and
projects group, Impacto Projectos e Estudos
Ambientais, Mozambique. Impacto are a
well-established environmental consultancy
in Mozambique which has provided a wide
range of environmental services for govern-
ment agencies, NGO’s and the private sector,
and it will complement Golder Associates’
international expertise with local knowledge
and experience.’

Golder Associados Moçambique Limitada
will join local professional associations in
Mozambique will become involved in hosting
local training events and seminars as part of its
community development strategies.

While the company is at present estab-
lishing and consolidating its presence, it will
move quickly to grow the office by local
recruitment strategies. In addition, it will be
fully committed to hosting and attending
high-profile marketing events.

One of the first high-profile events to be
attended by Golder was the Mozambique
Mining and Energy Conference (MMEC)
on April 16 and 17 at Joaquim Chissano
Conference Centre in Maputo.

LARGEST ROAD
REHABILITATION
PROJECT IN THE FREE
STATE APPOINTS WSP

WSP SA Civil and Structural Engineers (Pty) Ltd
have been appointed on one of the biggest
road rehabilitation projects ever to take place
in the Free State by the Free State Department
of Public Works, Roads and Transport. The ap-
pointment is for the rehabilitation of Route R59
which comprises roads P10/1 and P83/1 be-
tween the Vaal River at the Free State/Gauteng
border and the N1 in the Free State.

According to WSP SA Civil and Structural
Engineers Hennie Landman, the project, which
is a year into construction, is progressing well
and it is anticipated that the June 2009 com-
pletion date will be achieved.

The project comprises major pavement
rehabilitation and strengthening of Road P83/1
through the reconstruction of the existing

TRANSPORT
CONFERENCE AT CSIR

THE 27TH ANNUAL Southern African Transport
Conference and exhibition will take place
from 7 to 11 July 2008 at the CSIR International
Convention Centre. The Minister of Transport
will deliver the opening address.

Steve Phillips, Secretary-General of FEHRL
in Brussels; Professor Dinesh Mohan, WHO
Collaborating Centre, Indian Institute of
Technology, Delhi; and Lloyd Wright, Viva,
Peru, have been invited to present papers at the
plenary sessions.

Sessions to be presented are: Transport
Planning, Infrastructure, Rail and Transport
Logistics, Capacity Building / R&D, Traffic
Management and Safety, Public Transport and
Traffic Engineering.

In addition, the following will be pre-

tented:
- Workshop: MLS/MMLS Applications and
  Testing Protocols
- Workshop: BRT: Implementation
- SAICE Symposium: Progress on 2010

INFO

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INFO

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Civil Engineering

June 2008

Extensive geometric and safety improvements are being implemented to Road P10/1. A dual carriageway is being constructed with a 700 mm wide painted median from Route R57, just west of Vaalwater, to the Barrage Road intersection. From Barrage Road to the N1 freeway the existing road is also being upgraded and climbing lanes constructed at up-grades. The project also entails the widening of two existing bridge structures on Road P10/1, the construction of concrete bridge balustrades and the rehabilitation of five bridges in the Sasolburg vicinity.

**WORLD CUP TOURISTS WILL BE ‘SHOCKED AT DEARTH OF DISABLED FACILITIES’**

THERE IS AN URGENT need for architects and specifiers to fully understand the needs of people with physical impairment, says leading Johannesburg businessperson Eunice Forbes.

Forbes is founder and CEO of specialised sports surfaces supplier Fintrex and also the current president of Master Builders South Africa (MBSA).

Speaking in her personal capacity, Forbes – who herself is physically impaired after being stricken by polio as a child – says her business trips around southern Africa continuously reveal the dearth of facilities for the disabled.

‘It constantly shows that many architects are either lacking in their knowledge or apathetic regarding the needs of the physically impaired. They do not seem to realise that it goes far beyond just obligatory ramps, a few wide parking bays, and toilets for the disabled,’ Forbes stated. ‘Disabled overseas visitors to the 2010 FIFA World Cup are in for a shock when they land in South Africa.

‘I also believe the architectural profession generally avoids the risk of offending clients by standing up for the rights of the disabled when designing new public facilities. This is because there are cost implications and – more often than not – clients are not prepared to spend more than the bare minimum on facilities for the disabled which all too often dictates design.’

Forbes believes South Africans should strive to become automatically disability-conscious. ‘Architectural training should also place more emphasis on facilities for the disabled. Municipal authorities should not approve building plans with inadequate provision and central government needs to introduce more stringent legislation to protect the rights of physically impaired people – and see that the laws are enforced,’ she urges.

**INFO**

www.wspgroup.co.za

Eunice Forbes
Fintrex, Sandton
T 011-883-9867
COMPETITION RULES:

1. The competition is open to the general public to submit photographs.
2. It is essential that entries portray people and/or projects in civil engineering.
3. Photographs will be judged in ONE general category only.
4. Entries must be colour prints and in A4 size. Only quality prints will be accepted. Please supply electronic copies of the print/s in jpeg format, 300dpi.
5. Please complete an entry form for each entry and supply an appropriate title & short description of each project. It is essential that the photographer’s name is included.
6. Please supply details of the client, consultant and contractor involved in the project.
7. The entrant is responsible for obtaining permission for the use of the photographic material as well as subject material from the authority or project manager concerned.
8. Entries submitted by organisations must be accompanied by written consent of the photographer.
9. Permission for the reproduction of photos for any exhibition or publicity is assumed unless the entrant specifies otherwise. Due recognition will be given to the photographer.
10. No responsibility will be accepted for any loss or damage to entries.

NB*: The entrant’s name, address and title (all of which must correspond with details on the entry form) must appear on the back of the print.

This section must be completed by the person submitting the photo/s

| NAME__________________________ | ADDRESS______________________________________________ |
| TEL____________________| FAX______________________ | E-MAIL__________________________________________ |

PHOTO TITLE ____________________________________
DESCRIPTION___________________________________
________________________________________________
PROJECT INFO _________________________________
_______________________________________________

PHOTOGRAPHER__________________________
Name and surname of the photographer.

If you are not the photographer or if you are submitting the photograph on behalf of a company owning the photograph, please sign on behalf of.

I hereby grant permission for reproduction and agree to abide by the rules of the competition.

Signature:__________________________________

This section must be completed by the photographer or the company that owns the photo.

Please complete the entry form and send to: Private Bag X200, Halfway House, 1685. Fax: (011) 805 5971

This form is available on the SAICE website: http://www.civils.org.za/EventsAwards/PhotoCompetition/tabid/115/Default.aspx

Prizes sponsored by Sanlam COBALT

South Africa’s SMART legacy - cat’s eyes, the dolos, the impact roller, the CAT Scan, the Kreepy Krauly … Are YOU as SMART or SMARTer than this?

Do YOU have innovative ideas/projects/equipment to resolve, for instance,

- traffic congestion
- water conservation/recycling issues
- sustainable housing for healthy communities
- South Africa’s sanitation backlog
- ergonomic challenges for women in construction, e.g. lightweight tools

OR

- have YOU designed a small section of a BIG project that provides a solution, as for ALL the above, that is

  S  - sustainable
  M  - magnificent thinking/innovation
  A  - amazing solution
  R  - right for the time and place
  T  - truly and proudly Civils South Africa

If YOU answered YES to even some of the above, SAICE needs YOUR submission!
The SMART Awards are awarded to individuals and not to projects.

ENTRY FORM: Please contact Zina Girald on e-mail: zgirald@saice.org.za
ON 10 MARCH 2008, the University of Johannesburg conferred an honorary degree in civil engineering on Dr James L Barnard, internationally known pioneer and expert on biological denitrification and phosphate removal from wastewater.

The degree was conferred by Ms Wendy Luhabe, Chancellor of the University, during a graduation ceremony on the Auckland Park campus of the University of Johannesburg. The guest speaker was Dr Kevin Wall, well-known civil engineer at the CSIR – the same institution where Dr Barnard started his research career more than 40 years ago.

After the graduation ceremony, a select group of water engineering experts and guests attended a celebration dinner in honour of Dr Barnard at the Johannesburg Country Club. The event was co-sponsored by the University of Johannesburg and Golder Associates.

James Barnard was born on 6 June 1935. He graduated as a civil engineer at the University of Stellenbosch and spent a few years in practice before starting a research career at the CSIR’s National Building Research Institute in Pretoria in 1963. He left for the USA in 1967, where he obtained a master’s degree at the University of Texas and a doctoral degree in environmental engineering at Vanderbilt University. He returned to South Africa in 1971 as senior chief research officer at the CSIR’s National Institute for Water Research in Pretoria.

Three years later he was one of the primary forces to establish the company Meiring & Barnard in Pretoria, which developed into a leading South African water engineering consultancy – today known as Golder Associates. In 1993 he left Meiring & Barnard to become chief process engineer for Reid Crowther in Vancouver. Since 1998 he has been the global technology practice leader and senior process specialist at Black & Veatch in Kansas City. Both these companies are eminent engineering consultancies with high international profiles.

At the time when Barnard returned to South Africa in 1971 after his doctoral studies, a growing environmental awareness dictated that the high levels of phosphorus and nitrogen in wastewater should be significantly reduced before treated wastewater is returned to natural streams. The common belief, then, was that these contaminants could only be removed by adding more chemicals to the water. As the available chemical methods left much to be desired in terms of expense, dependability and environmental impact, Barnard turned his attention to the alternative biological removal of nitrogen and phosphorus.

He soon found that the conventional wastewater treatment process could be adapted to remove almost all nitrogen without the addition of any chemicals. These findings, first published in 1973, triggered intensive research all over the world. Within three months of Barnard’s momentous discovery of nitrogen removal, the concept was accepted by the City of Johannesburg for the design of three large new nitrogen removal plants, putting the city on the cutting edge of wastewater treatment technology. Barnard then turned to the remaining problem of phosphorus removal, and after two more years of intensive laboratory, pilot plant and literature studies, he demonstrated not only how phosphorus could be biologically removed, but also unravelling the complicated biological pathway of the process. This paved the way for the application of biological phosphorus removal to full-scale wastewater treatment. The idea that nitrogen and phosphorus could be reduced in the same biological process was revolutionary and met with disbelief and skepticism by many scientists and engineers. Despite discouragement from the industrial, commercial and academic communities, Barnard persisted in his pursuit of both scientific understanding and practical application. His research opened the door to one of the greatest advances in wastewater treatment ever, eventually leading to thousands of nitrogen and phosphorus removal applications throughout the world.

Barnard is universally recognised and revered as the creator of biological nitrogen and phosphorus removal. As a pioneering engineer, scientist, researcher and teacher, he has touched the lives of millions, some as individuals and others as an anonymous guardian of earth’s water – an irreplaceable resource. Dr James L Barnard’s contribution will continue to have a profound effect on the lives of millions, for many years to come.
welcomed the guests. Dr Andre van Niekerk, director of Golder Associates, then traced the genealogy of Golder Associates to the consulting firm of Meiring and Barnard, which was established in the early 1970s by Dr Barnard and Mr Piet Meiring, who was also present. A short address by Professor Theo Andrew, executive dean of the Faculty of Engineering, was followed by a toast to civil engineering by Professor Johannes Haarhoff. Mr Piet Odendaal, retired director of the Water Research Commission, proposed a toast to Dr Barnard.

In his response, Dr Barnard urged the industry to rise to the next challenge awaiting wastewater treatment, namely not only the removal of phosphate from wastewater, but the recovery of phosphate to replenish the rapid dwindling world supply of phosphate, having grave consequences for the world food supply.

The evening was rounded off by messages and impromptu contributions by Eric Hall (retired Johannesburg City Engineer), Lucas van Vuuren (previously a colleague of Barnard at the CSIR), George Ekama (professor at UCT) and Johannes Haarhoff (UJ).

IT IS WITH A SENSE of great sadness and loss that we have to announce the death of Jaco de Wet, one of the key members of the magazine and journal team, on 24 May 2008.

Jaco died after sustaining multiple injuries in a car accident near Matla. He was 32.

As chief graphic designer at Marketing Support Services, in Pretoria, Jaco always impressed with his creativity, meticulous attention to detail and professionalism. As such, his contribution to Civil Engineering winning a PICA Award last year cannot be underestimated.

Jaco also had another link to the civil engineering profession. One of his brothers, Gerhard, works for BKS in Pretoria.

Ons gedagtes gaan uit na sy vrou, Gerieke, sy kinders, Abrie en Wieke, ander lede van die familie, en natuurlik sy kollegas. He will be sorely missed – also as a friend.

Sarie Moolman
Die takbesoek vir 2008 het vroeg begin toe ons delegasie van vier op 27 Februarie kort na agtuur op David Leukes se vriendelike span daar by Frans Ferreira-hulle se kantore toegesak het.

Die Upingtonners weet hoe om te organiseer en ’n vars span het telkens oorgegeneem. Na ’n gesellige ontbyt saam met Frans, was ’n besoek aan ’n jong besigheid wat lasappie-kunswerke maak, en sodoende werk skep, eerste op die lys.

Die span van Vezokuhle Creative Textile Mosaics maak die mooiste goed, soos muurbehangsels, kussings, sakke en teemusse, uit snippertjies lap en weggooi-wynsaakfoelie. Hul pragtige produktes doen hul naam verseker gestand – Vezokuhle is die Xhosa-woord vir ’om skoonheid te toon’. Sedert 2005 word Vezokuhle deur die Department van Kuns en Kultuur erken en ondersteun as ’n opwindende nuwe onderneming. Gerty Willemse, wat ons rondgeneem het, se entoesiasme vir die saak is aansteeklik, maar vir Vezokuhle om lewensvatbaar te bly, benodig hulle deuriopende ondersteuning.

Die KWV se brandewynstokery en die druiewas-konsentraataanleg was volgende op die lys. Altus Theron het ons deur sy netjiese aanleg geneem en onderhoudend gesels oor die prosesse wat in ketel op hittige ketel aan die gebeur is en oor hoe en waar die plaaslike siviele-engenieursbedryf sy aanleg verbeter het.

So sonder ophef en trompetgeskal maak Upington se bedrywe ‘n groot bydrae tot uitvoere en plaaslike vrolikheid in die vorm van sap, wyn, brandewyn, spiritus, en droë en vars vrugte. Intussen toets die Duitsers ook steeds hul vinnige motors hier in die bloedige hitte op die Kalahari se drumpel.

The evening event at Kelvin Grove saw the Cape Town faithful – and some of the stalwarts – turn up to hear the president speak. Professor Derek Sparks, John English, Dr Ross Parry-Davies, Dr Graham Ross, Louis de Waal, Brenda Sudano – all were there to welcome us. How nice to be their colleagues and comrades in arms …

The Friday circuit included a talk at the Bellville campus of the Cape Peninsula University of Technology. As usual the students were there en masse – a responsive and friendly audience, indeed! Many thanks to HOD Ashaadia Kamalie for hosting us.

Next stop – beautiful, busy Stellenbosch, and yet another student audience. If all these bright-eyed young people enter the profession, we will be in good hands. We salute the academic staff who are fulfilling an enormous task in difficult circumstances, as we learnt during an informal get-together in the staff room afterwards. Many thanks to the engineering staff of the University of Stellenbosch – especially HOD Christo Bester – for the warm reception.

It was already past three when the team was released to savour a bit of the glorious Cape. A great thank you to Marianne Vanderschuren and team!

**WESTERN CAPE**

After a solid breakfast in Upington, the single muffin that has replaced the Airlink breakfast had no takers from our team.

We arrived in Cape Town as scheduled, but our hopes of being on time at the University of Cape Town were dashed by baggage bumbling. I remain unimpressed by ACSA and their contractors – especially when you have to wait such a long time for your luggage and particularly when if the hordes of airport staff leaning against pillars and lounging in chairs are so unhelpful when asked for assistance! Perhaps ACSA should bear in mind that the days left to 2010 are steadily getting fewer …

At the University of Cape Town, Neil Armitage’s students were patiently waiting to be addressed by the SAICE president. Some interesting questions from the audience had the president and executive director thinking on their feet!

From UCT we went to Valkenburg farm for lunch at the Fig Tree Restaurant. The rest of the afternoon was taken up by a lively committee meeting chaired by Marianne Vanderschuren. We were amazed at how almost every item on the agenda elicited input and comment.

SAICE is indeed alive and well in the Cape!

Dawie Botha
<table>
<thead>
<tr>
<th>Date</th>
<th>Event and CPD validation number</th>
<th>Presenters/venue</th>
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<tr>
<td>17–18 July – Durban</td>
<td>Engineering and Construction Short Contract SAICEcon08/0031/11</td>
<td>Chris Wentzel</td>
<td>Cindy <a href="mailto:cindy@tcq.co.za">cindy@tcq.co.za</a></td>
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<td>25–27 June – Durban</td>
<td>Project Management with Microsoft Project SAICEproj07/00181/10</td>
<td>Andrew Holden</td>
<td><a href="mailto:andrew@classic-sa.net">andrew@classic-sa.net</a></td>
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<td>21–27 June – Gauteng</td>
<td>The Application of Finite Element Method in Practice SAICEstr06/00018/08</td>
<td>Roland Prukl</td>
<td>Dawn Hermanus <a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
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<td>22 June – 19 July – Stellenbosch</td>
<td>Construction Management Programme SAICEcon07/00199/10</td>
<td>University of Stellenbosch <a href="http://www.cpm.sun.ac.za">www.cpm.sun.ac.za</a></td>
<td>Alett Slabbert 021-808-4363 <a href="mailto:alett@sun.ac.za">alett@sun.ac.za</a></td>
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<td>Design of Masonry Structures</td>
<td>A N Fried, H C Uzoebgo, O J Kanyeto <a href="http://www.wits.ac.za/enterprise">www.wits.ac.za/enterprise</a></td>
<td><a href="mailto:swanepoellj@enterprise.wits.ac.za">swanepoellj@enterprise.wits.ac.za</a> <a href="mailto:hczuozebgo@wits.ac.za">hczuozebgo@wits.ac.za</a></td>
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<td>1–3 July – Heidelberg</td>
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<td>Chris Wentzel</td>
<td>Cindy <a href="mailto:cindy@tcq.co.za">cindy@tcq.co.za</a></td>
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<td>14–15 July – Durban</td>
<td>Business Finances for Built Environmental Professionals SAICEfin06/00004/08</td>
<td>Wolf Weidemann</td>
<td>Dawn Hermanus <a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
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<td>Dawn Hermanus <a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
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<td>22–23 July – Gauteng</td>
<td>Basic Construction Estimating &amp; Planning SAICEcon06/00106/09</td>
<td>Phil Watson</td>
<td>Sharon Mugeri <a href="mailto:Cpd.sharon@saice.org.za">Cpd.sharon@saice.org.za</a></td>
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<td>4–5 August – Gauteng</td>
<td>Soil Stabilisation SAICEstr06/00024/08</td>
<td>J Coetzee</td>
<td><a href="mailto:Sarfusel@acenet.co.za">Sarfusel@acenet.co.za</a></td>
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<td>18–20 August – Port Elizabeth</td>
<td>Environmental Management for the Roads</td>
<td>S Ballot</td>
<td>SARF <a href="mailto:sarfusel@acenet.co.za">sarfusel@acenet.co.za</a></td>
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<td>27–31 October – Gauteng</td>
<td>Tailings Course 2008 SAICEcon07/00232/10</td>
<td>Beric Robinson</td>
<td><a href="mailto:beric@fraseralexander.co.za">beric@fraseralexander.co.za</a></td>
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<td>24–26 November – Cape Town</td>
<td>2nd International Conference on Concrete Repair, Rehabilitation and Retrofitting <a href="http://www.civil.uct.ac.za/icccrr">www.civil.uct.ac.za/icccrr</a></td>
<td><a href="mailto:icccrr@eng.uct.ac.za">icccrr@eng.uct.ac.za</a> 021-689-7471</td>
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For more information on courses, venues and course outlines please visit http://www.civils.org.za/courses.html or contact cpd.sharon@saice.org.za